

REPORT
ON
THE ADMINISTRATION
OF THE
METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA
IN
1883-84.

IN accordance with the practice of previous years, I preface the formal portion of my report on the working of the Meteorological Department in the year ending 31st March 1884, with a brief notice of some of the more important incidents of the year, and of the subjects to which attention has been more particularly directed.

ACTINOMETRIC OBSERVATIONS.—In the report for 1882-83, I recounted the steps taken, up to date, for training the actinometric observers to be sent to Leh, and to verify, by an ample comparison with arbitrary standards, the instruments they were to take with them. As the supply of the latter, originally sent out, proved to be in part of inferior quality, and had been seriously reduced by breakage, it was necessary to detain the observers in India until the arrival of a further supply of thermometers and the completion of their subsequent verification. The instruments arrived in May 1883, but the season of clear skies was now at an end; and although every available opportunity was utilized for carrying on the work during the rains, it was not until the end of September that it was brought to a close,—the instruments packed for safe transport across the passes, and every thing made ready for the start. Sergeant Rowland and Mr. Shaw left Dehra on the 2nd October, and reached Leh, *via* Murree and Srinagar, after a month's journey, arriving there on the 2nd November. All the instruments arrived in excellent order.

Their work at Dehra had been carried on under the direction and personal superintendence of Mr. Hennessey, who devised several improvements in the instruments, and organised the scheme of their work. The results of this experience he has embodied in a pamphlet of elaborate instructions, specially drawn up for the guidance of the observers,—itself an important contribution to science, and which will probably serve as the basis and guide for all future systematic work in actinometric observation. I cannot

omit to repeat the expression of my great indebtedness to Mr. Hennessey, for his valuable co-operation in organising the scheme and directing the preparations for the important work now in progress.

I have received the results of the observers' work, for the months that have elapsed since their arrival at Leh up to the end of May. Hitherto the season has proved most unfavourable. The winter and spring months have been unusually stormy in the North-Western Himalaya, the skies have been greatly obscured by cloud, and opportunities for good observation have been very rare. This is to be regretted; but it was to be anticipated that the winter observations would prove more interrupted than those of the summer, and it is to those of the summer season, when the declination of the sun is higher, the thickness of the absorbing atmosphere consequently less, and the serenity of the skies greater, that we must look for the most important results of the work.

HIMALAYAN SNOWFALL REPORTS.—In last year's report, I set forth the reasons which have led me to attach great importance to the acquisition of detailed and regular information on the state of the Himalayan snows and of the weather prevailing over the higher ranges of the mountains. And in accordance with the recommendations of the report, those passages which bore on this subject were extracted and widely circulated to officers stationed in the hill states, and whose duties bring them into communication with travellers and traders in the interior of the mountains, with the request that they would endeavour to obtain and communicate speedily to this office, from month to month, the fullest information procurable on the extent and thickness of the snows. As the result of these measures, the statistical accounts received of the snowfall of the past winter and spring have put me in possession of a body of most valuable information, —the more valuable that, throughout the higher ranges to the north-west of the Sutlej, the snowfall of the past winter and spring has been unusually heavy, while that of the outer ranges, from Kangra eastwards, has been as conspicuously deficient, and that of the inner ranges of the Central Himalaya has been much below the average. The distribution of the snows being thus known, we are enabled to trace out, with more precision than hitherto, the influence of the snow fields on the dry winds of the plains, and in this respect the experience of the present year will prove more than ordinarily instructive.

CONNECTION OF THE SNOWS WITH DRY LAND WINDS.—The views put forward in last year's report of the influence of the snows as favouring the prevalence of dry westerly winds in Northern India have been so far uniformly confirmed by the further experience of the past year.

In the spring of 1883, there was a heavy and late precipitation on the first or outer snowy range of Hazara, Murree, Kangra, Kulu, and Bussahir; and, relying on the experience previously gained, I ventured to put forward a warning in the *Gazette of India* of the 2nd June, to the effect that the monsoon rainfall of the North-Western India would probably be retarded, and that there would be a long spell of dry winds on the plains. The result was that an interrupted, sporadic, but locally heavy rainfall in the first half of July was followed by a long break, which began in the Punjab, speedily extended to the North-Western Provinces, Rajputana, Khandesh, Berar, and even the Konkan and Deccan, and lasted up to nearly or quite the end of August.

A further confirmation of the above view was afforded by the meteorology of the winter months. As a general rule, little or no snow falls on the Himalaya before Christ-

mas or the beginning of the new year, and it is then accompanied by a more or less copious rainfall on the plains of North-Western India. Last season, however, there was a fall of snow in Kashmir as early as September, and very generally on the North-Western Himalaya in October; and early in November a very heavy fall took place everywhere to the north-west of the Sutlej. The cold season which followed on the plains and the outer Himalaya was remarkably fine,—dry cool north-west winds prevailed, with unbroken steadiness; and in Northern India, over the greater part of the Gangetic plain, and in a large area of Western India, the four months, November to February, were absolutely rainless.

Judging from present appearances, the experience of the approaching monsoon will furnish further valuable evidence as to the influence of the snows; the spring fall in Kashmir and Lahoul having been unusually heavy and also prolonged.

A paper on the connection of the Himalayan snowfall with dry winds and seasons of drought in India was lately communicated to the Royal Society of London and read at the meeting of the 1st May. In this paper, which I understand will shortly be published in the Proceedings of the Society, I have given a *resumé* of the evidence from which the above connection has been inferred. Each successive year will add to this evidence, and develop the precise character of the connection, and I anticipate, with confidence, that before many years shall have elapsed, it will be possible to forecast the prospects of any given season, at all events for North-Western India, with more precision than has hitherto been possible for this or any other country in the world.

HIMALAYAN OBSERVATORIES.—Hitherto, with the exception of Leh on the Upper Indus Valley, the only observatories for the registration of Himalayan meteorology have been those at the hill stations,—Murree, Simla, Chakrata, Mussooree, Pauri, Ranikhet, Pithoragarh, Katmandu, and Darjeeling,—all of which are on or among the outer hills, at some distance from the permanent snows. It has long been an object to obtain additional meteorological registers from the interior of the mountain tract, but there has been some difficulty in effecting this, owing to the paucity of residents, of sufficient education and intelligence to undertake the charge of the work. During the past year, through the kindly volunteered assistance of the Rev. A. Heyde, an observatory has been established at Kailang, in Lahoul, at an elevation of 10,000 feet above the sea, and to the north of the second snowy range. Mr. Heyde has been at much pains to establish the instruments in accordance with the official instructions and to obtain a properly trained observer, and in addition to the registers, which were commenced in July 1883, his personal observations on various meteorological phenomena are particularly valuable, and such as can only be furnished by an educated and observant person.

Another observatory, less remote but still within the influence of the snowy range, has lately been fitted up at Chamba, with the kind assistance of Major C. H. Marshall, the Superintendent of the Chamba State, and Dr. Hutchinson, the Resident Medical Missionary. I expect shortly to receive registers from this observatory.

INSULAR OBSERVATORIES.—With a view to ascertaining, as far as possible, the current meteorological conditions of the oceanic region, which is the source of the Indian summer monsoon, observatories have been established at Zanzibar, the Lakhadives, and the Seychelles. That at Zanzibar has now contributed registers since January 1880, first as a voluntary observatory; and in 1881, being brought on the list of paid observatories, it was raised to the status of one of the second class. The work has continued good,

and it would be a serious loss were it now to cease. Last year there appeared to be some danger of this, owing to the transfer of the political establishment of the station to Her Majesty's Foreign Office¹ and the consequent withdrawal of the medical officer, who has superintended the observatory. The Surgeon-General of Bombay has allowed the observer to remain at his post for a time, pending the reply of Her Majesty's Government to the application that the observatory may be taken over by the Foreign Office and continued. As yet no reply has been received to this application.²

The observatory at Amini Divi was established in September 1880, although no report of the fact was received until long afterwards, and no mention is made of it in the Administration Report for that year. The observer, a subordinate medical officer, was trained in Madras, but it would appear that either the man was naturally inefficient, or his training imperfect. In any case, his registers are of little value. Those from January 1881 to April 1882 have been entirely rejected, and those for the subsequent months of 1882 are very imperfect, while they have ceased altogether since that date. This observer has been recalled, and he has been succeeded by another man, from whom, as yet no registers have been received in my office. This observatory has been under the Meteorological Reporter to the Government of Madras.

The Seychelles observatory was equipped in 1882, but the first registers contributed were those for June 1883, since which they have been received regularly up to January 1884. They appear to be fairly good as far as they go, but many important observations are deficient. As the Meteorological Officer of the Mauritius Government has also an observer here, it is desirable, if possible, that the two Departments should co-operate, and I have had some correspondence with Mr. Meldrum, the Meteorological Officer of the Mauritius, on this subject. There is much difficulty in controlling these remote observatories, as there is, as a rule, no one on the spot, having any technical knowledge of meteorology, and the observers are necessarily left to the guidance of their own intelligence with such assistance as they can obtain from the printed instructions.

FIRST CLASS OBSERVATORIES IN INDIA.—It was proposed as a part of the scheme of re-organisation sanctioned by Government in 1875, that in addition to the then existing first class observatory at Bombay, observatories furnished with autographic instruments should be established at Calcutta, Allahabad, and Lahore. The first of these was provided under the Lieutenant-Governorship of Sir G. Campbell, who erected a suitable building for the purpose at Alipore, and this has now been working steadily and with satisfactory results since the spring of 1877. Owing to the want of buildings in any suitable site, the provision of similar observatories at Allahabad and Lahore has hitherto remained in abeyance, and, in fact, as regards suitability of site, the existing observatories at both these seats of Government are far inferior to those at the large majority of the minor stations.

It is therefore with much satisfaction that I am able to report that at Lahore there is, at length, a prospect of a suitable building being shortly placed at the disposal of the Department. Shortly after the close of the official year, I visited Lahore, chiefly with a view to this object, and I there learned that a building, the property of Government, situated in a very excellent site, would shortly be vacated, and might probably be made

¹ On the 1st September 1883.

² I regret to report that, no reply having been received from the Home Government, and the services of the observer being urgently required by the Medical Department, it has been necessary to close the observatory.

available as an observatory and office for the Meteorological Reporter. This proposal has received the approval of the Lieutenant-Governor of the Punjab, and the building in question will be made over to the Meteorological Department in July, when steps will be taken, with as little delay as possible, to carry out the original scheme.

In the case of Allahabad, a suitable site has been obtained in the Chatham lines, and although, owing to financial considerations, it has been found necessary yet again to defer the erection of the permanent building, it is proposed to erect a temporary observatory on the spot, and commence observations for the purpose of determining the extent to which the proposed change of site will influence the normal values of the observations, especially as regards temperature and humidity. I would fain hope that this preliminary measure may be carried into effect at an early date. Every delay increases the risk of losing a sufficiently long comparative record ; in which case, much of the utility of the registers of the present observatory, now extending over nine years, will be lost to science.

REGISTRATION OF RAINFALL.—In former reports, I have given an account of the steps taken to obtain registers of rainfall from those portions of India which, up to 1881, were entirely unrepresented in the records of the Department. There were then two extensive tracts, one in the peninsular and the other in North-Western India, the rainfall of any portion of which could only be vaguely inferred from that of the surrounding regions. The first of these was the comparatively wild and inaccessible country, lying between the Central Provinces on the one hand and Chutia Nagpur, Orissa, and the Northern Circars on the other, and comprising an area of about 150,000 square miles. The other was the desert region of Western Rajputana with the Native States of Khyrpore and Bahawalpore, measuring approximately 65,000 square miles. In former reports, I have recounted the steps taken to establish raingauges in South Rewah, Sirgajah, the Tributary Mehals, the eastern districts of the Central Provinces, Bastar, Jeypore, and the zemindaries of the Northern Circars, all included in the former tract. This is now represented by the following stations :—

Chandia	in South Rewah.	Kunjabangar	in the Tributary Mehals.
Sohagpur	„ „	Saragaon	„ the Central Provinces.
Dudhi	„ Mirzapur.	Raigarh	„ „
Palamow	„ Chutia Nagpur.	Sarangarh	„ „
Lohardugga	„ „	Dhamtari	„ „
Sirgajah	„ Sirgajah.	Bastar	„ Bastar.
Jushpore	„ the Tributary Mehals.	Naurangapur	„ Jeypore.
Gangpur	„ „	Kotipad	„ „
Keonjhour	„ „	Koraput	„ „
Talchir	„ „	Malkanagiri	„ „
Angul	„ „	Gunipur	„ the Northern Circars.
Denkanal	„ „	Rayaghadda	„ „
Bispara	„ „	Narsapatam	„ „

In Western Rajputana, a thinly-peopled tract of very light and precarious rainfall, raingauges have now been established at the following stations ; at all but Bickaneer and Pachbadra, within the last year :—

Bickaneer.	Jessulmere.
Jasol.	Barmer.
Pali.	Pachbadra.
Nagar.	

In some parts of Bengal and of the Madras Presidency, where the rain-gauge stations sending registers to the Central Office were somewhat thinly scattered, and insufficient fairly to represent the average rainfall of the tracts in question, some additions have been made to the list, by selections from the sub-divisional stations already provided with gauges, and nearly the whole of India is now fairly well represented in the published returns.

CHART OF AVERAGE RAINFALL OF INDIA.—In last year's report, I described the chart of the average rainfall of India which had been prepared in the office and was then in the lithographer's hands. It was completed and printed in colours by December 1883, and the first copies were exhibited at the Calcutta Exhibition. Judging from the requisitions that have been received for copies of this chart, I believe that it has been found of much use by administrative officers and others.

Charts, on a smaller scale, have been prepared showing the average distribution of the rainfall in the principal seasons of the year, *viz.*, the cold season (November to February), the hot season (March to May), and the rains, but these have not as yet been lithographed.

SEISMIC OBSERVATORIES.—The registration of earthquake phenomena is a branch of terrestrial physics, but remotely connected with meteorology; but, inasmuch as it requires for its prosecution the establishment of fixed observatories, it has been found convenient to utilize certain of the existing meteorological observatories for the purpose. In 1882, in consequence of a representation from the Superintendent of the Geological Survey, a sum of Rs. 2,000 was allotted for providing a simple form of seismic apparatus and sheds for its protection, the arrangements being entrusted to the Superintendent of the Geological Survey in conjunction with myself. The iron sheds proving more costly than had been originally anticipated, the number of proposed observatories had to be reduced to three, only one of which is provided with the full set of apparatus, and the stations of Silchar, Sibsagar, and Shillong were selected for the purpose. The apparatus consisting of Mallet's cylinders and post (with bronze spheres) was constructed at the Mathematical Instrument Department. Working drawings of the shed were prepared and forwarded to the stations in question, and during the last cold weather the sheds were constructed and the apparatus set up.

When on my recent tour of inspection, I found the arrangements completed at Shillong and Silchar, and I determined the azimuths of these two observatories. That of Sibsagar was incomplete; the meridian line was however fixed, and the verification of the azimuth must be made on the next occasion of visiting the observatory.

The registers are transmitted to the Superintendent of the Geological Survey.

INSPECTION OF OBSERVATORIES.—The inspection of observatories has been adverted to, in previous reports, as one of the most important duties of the Meteorological Reporters. Thirty-three observatories have been inspected during the year by one or another of these officers, and seven by the Sanitary Commissioners of the Central Provinces and British Burmah,¹ but in the case of most of the Reporters, indeed all those who hold other offices in addition to their Reporterships, the occasions on which they are able to absent themselves from head-quarters in the performance of this duty are rare, and thus it frequently happens that observatories, the work of which is far from satisfactory and

¹ Exclusive of the five observatories at the Reporters' head-quarters.

which urgently require inspection, are left for months unvisited, owing to the inability of the local Reporter to leave his local office. In the case of stations not accessible by rail, steamer, or horse dâk, such as those in Western Rajputana and some of those in the Central Provinces, the consumption of time in the mere performance of the journey to reach them is such as to be practically prohibitive of inspection; thus it happens that Raipur, Sambalpur, Pachbadra, Quetta, Leh, Mercara, Tounghoo, and some others have never yet been visited by any Meteorological Officer; and Bickaneer, Seoni, Chanda, Dera Ismail Khan, Sibsagar, and most of the Burmese observatories have been inspected but once during the many years of their establishment. Under these circumstances, some of the local Reporters, *viz.*, Dr. Neil and his successor, Dr. Lawrie, in the Punjab, Miss Pogson in Madras, and recently Mr. Eliot in Bengal, have endeavoured to utilize the services of their head clerks to carry out the needful inspection, furnishing them with such instructions as they deem necessary, and with the guidance of some practical experience of work in a local observatory and that of the official book of instructions. Mr. Eliot and Dr. Lawrie, in their reports, both speak very favourably of the result of this measure; and I have never doubted that, when intelligent men of this class, properly coached in their duties beforehand, are so employed, they may be very serviceable. Indeed it was in this conviction that I proposed, in 1881, to add a travelling instructor to the head office, whose duties would be very similar to those actually performed by the head clerks of the offices referred to.

But it must not be supposed that, by any such measure, the Reporters can be entirely relieved of the duty of inspecting their observatories. Where, as in the majority of cases, the shortcomings of observers are due to their neglect or misapprehension of the rules laid down for their guidance, and to their departure from the prescribed routine, an intelligent head clerk or chief observer is quite able to do all that is required. But the knowledge of these men is purely empirical; and when therefore the registers of an observatory are affected by some cause or condition, not specially noticed in the official instructions, and which it requires a trained judgment to detect and estimate, only an officer of scientific experience, and with a good practical knowledge of physics, can decide wherein the work of an observatory is at fault and how it may best be remedied. And there are certain portions of an inspector's routine work, which require more experience in the details of manipulation, than men ordinarily engaged in clerical duties can well perform—such as verifying thermometers and cleaning barometer cisterns, with such appliances only as are available at the observatories.

The conclusion that I draw is this. Reporters should visit every observatory in their province once at least, and as soon after their appointment as possible. They should also inspect them subsequently, from time to time, as far as may be practicable; and only in the event of their inability to visit a station which stands in urgent need of inspection, or when the difficulty to be met is believed to be such as a subordinate officer can cope with, should such an officer be employed on the duty.

BENGAL PROVINCIAL SYSTEM OF TELEGRAPHIC REPORT.—In the latter part of 1882, a scheme was drawn up by Mr. Eliot, at the instance of the Government of Bengal, for establishing a local system of daily telegraphic weather report during the rainy season. For the information of the Provincial Government and its administrative officers, it was desired to obtain more ample information of the current phases of the weather than is

afforded by the 16 observatories which form part of the imperial system in that Province; and also to disseminate this information more rapidly and widely to the local officers, than is practicable from the Simla office. It was arranged that the additional expenditure to be incurred to the Meteorological Department should be met by an allotment of the provincial revenues, to be placed at the disposal of the Imperial Government; the general control being, like that of all other meteorological establishments, vested in the Reporter to the Government of India.

In Mr. Eliot's Administration Report (Appendix A), will be found a very full account of the measures adopted to give effect to this scheme, which came into operation, on the 15th May 1883. Twenty-two additional observatories were established in different parts of Bengal, making, together with the sixteen existing Imperial observatories, a total of 38 for the province. Of these, 31, which are in telegraphic communication with Calcutta (including the Alipore Observatory), transmit to the Bengal Office a daily telegram of the observations recorded at 10 A.M., from the 15th May to the 15th November; and these, after correction and reduction, are published daily in a tabular form, together with a general description of the weather phases of the day. The preparation of this report is completed and sent to the Bengal Secretariat Press by 4 P.M., where it is printed and distributed from the press in time for the outgoing evening mail.

In addition to the daily report of the general weather, Mr. Eliot publishes a weekly statement, giving the average and extreme variations of the meteorological elements for the week at all observatories, and the rainfall returns for the week, recorded at 166 stations. These latter are transmitted by post cards, despatched daily whenever rain is registered, and a weekly return is also forwarded as a check on the daily despatch. From a few remote stations the latter are transmitted by telegraph.

The working of the system is, therefore, accomplished with great fulness and despatch, and reflects very great credit on Mr. Eliot's administrative capacity and energy. The amount of additional personal work that it imposes on the Reporter to the Government of Bengal is very considerable, since all but the mechanical tabulation of the data falls upon him personally, and this both for the daily and weekly reports, and is an addition to the daily storm service reports, which are prepared and issued daily throughout the year. The personal work thus falling on Mr. Eliot is probably double that accomplished by any other local Reporters, not excluding those who have no other duties to discharge. And it is work of a most arduous and exacting kind. From April to November two reports have to be prepared and issued daily, without a single day's remission, and since Mr. Eliot has no assistant to relieve him of the duty, and it is carried on in an exhausting and trying climate, whether ill or well, he has still to carry through the work.

CALCUTTA EXHIBITION.—A small court in the Indian Annexe of the Calcutta International Exhibition was occupied by the Meteorological Department for the exhibition of a Van Rysselberghe meteorograph, instruments of various kinds for measuring the solar heat and the humidity of the atmosphere, and a series of meteorological charts, specially prepared for the exhibition, to illustrate the monthly variations of barometric pressure and winds of India, of temperature, and the distribution of cloud; also of the rainfall of Bengal in the rainy months, and that of the whole of India in the three principal seasons of the year and on the general average of the year; the last being the lithographed chart already referred to.

PART II.—OBSERVATORIES.

In the Report for 1882-83, I enumerated 126 observatories which contributed registers to the Meteorological Office up to the close of the year; of which number, thirteen were either independent or attached to Government Offices and not paid for by the Department, and six were private or foreign observatories. Excluding the 22 new observatories which have been established in Bengal as part of the provincial system, the only additions made during the past year are—

Kailang or Kyelang in Lahoul	(3rd class)
Seychelles Islands	(do.)

both of which had been furnished with instruments in the previous year. The first of these began to contribute registers in June 1883, the second in July 1883. Three other observatories, *viz.*, Cuddapah, and Rajahmundry in Madras, and Chamba in the N.-W. Himalaya, were furnished with instruments, but had not begun to contribute registers before the end of the year.

The voluntary observatory at Paori in Kumaon having ceased to contribute registers since the 30th November 1883, the net addition to the list of observatories is one only, and at the end of the year the total number was 127. But 128 contributed registers during, at least, some part of the year. These were distributed as follow:—

<i>Indian Empire.</i>	
Bengal and Assam	22
North-Western Provinces and Oudh	18
Punjab	12
Central Provinces	11
Berar	5
Central India and Rajputana	10
Bombay	14
Madras, Mysore, Coorg and Hyderabad	17
British Burma	8
Bay Islands	2
Lakhadives	1
TOTAL	120

<i>Extra Indian Settlements and Foreign States.</i>	
Nepal	1
Kashmir territories	1
Baluchistan	1
Goa	1
Persian Gulf	1
Aden	1
Zanzibar	1
Seychelles	1
TOTAL	8
GRAND TOTAL	128

Of the whole number, three are first class observatories with instruments registering autographically, twenty-six second class observatories, at all but two of which, in addition to observations at 10 hours and 16 hours daily, hourly readings are registered on four

(or in some cases three) days in each month, and at all but one of these latter, synoptic observations are registered daily at 7 hours Washington mean time (=18 hours 1 minute Calcutta mean time). The remainder, with five exceptions, are third class stations, registering two full sets of observations; and, in the case of certain of the Madras stations, three sets daily. The five excepted stations, Chowringhee (Calcutta), Mongpoo, Tura, Demagiri, and Makhla, register only temperature, rainfall, and wind direction. The observatories may further be classed as—

	Class.			
	1st.	2nd.	3rd.	4th.
A.—Government observatories with paid observers under the Meteorological Department	1	25	82	1
B.—Independent observatories or attached to Government Offices, observers not paid by the Meteorological Department	1	0	7	4
C.—Private and foreign observatories	1	1	4	0
TOTAL	3	26	93	5

OBSERVATORIES IN BENGAL AND ASSAM.—*The Alipore Observatory.*—This observatory serves as a general depôt for the verification of instruments, as well as for observations of an experimental character, and an important part of the work is the working of the time signals for the port of Calcutta. It is immediately superintended by the Reporter to the Government of India, and the establishment is under the immediate charge of the Chief Observer, Babu Brojo Mohun Rukhit, B.A. During the past year, the work of the observatory has consisted of—

1st.—Continuous registration, by autographic instruments of (a) the duration of bright sunshine, (b) the atmospheric pressure, (c) temperature, (d) moisture (dry and wet bulb thermometers), (e) wind direction, movement and pressure, and (f) rainfall.

2nd.—Periodical readings, four times daily, of the barometer, dry and wet bulb thermometers, and estimates of cloud proportion; once daily of the maximum and minimum thermometers in shade, those of the exposed thermometers for nocturnal radiation and insolation; and thrice daily those of the ground thermometers at the surface, 1 foot, 3 feet, and 6 feet deep. Also occasional observations on the movements of the higher clouds by means of the nephoscope.

3rd.—The verification of all thermometers issued to observatories throughout India, with the exception of those under the Meteorological Reporter for Western India; and the comparison of all barometers with the Calcutta standard.

4th.—The determination of the mean local time, by meridian observations of the sun, and the working of the time signals for the guidance of the shipping in the port. Also the custody and rating of Government chronometers.

The actinometric observations, with a Stewart's actinometer, were discontinued in 1883. The above purposes consists of—

Rukhit, B.A.	Chief Observer.
Mr. Mukerjee*	} 1st Photo. Asst.
Mr. Banerjee†	
Mr. Banerjee*	} 2nd Ditto.
Chuckerbutty‡	

1883.

† From 6th May 1883.

‡ From 1st June 1883.

Babu Mohendra Nath Banerjee Observer.
 „ Shyam Lall Sen Ditto.
 2 Artificers.
 1 Batteryman.
 6 Servants.

The autographic instruments consist of a sunshine recorder, the Kew barograph and thermograph, which register by photography, a Beckley's anemograph, an Osler's anemometer, and a Beckley's rain gauge. During the past year all these instruments have worked fairly well. There were, indeed, several temporary interruptions in the action of the photographic instruments, owing either to the stopping of the driving clocks, the failure of the illuminating arrangements, and, in the case of the thermograph, either to the trace running beyond the illuminated zone, when the range of temperature was very great in the hot weather, or to the drying of the muslin in the covered bulb when the evaporation was very rapid in the hot weather. All these are failures that may be avoided by proper attention, and having impressed on the chief observer the discredit that attaches to such imperfect work, I am glad to report that by increased attention to the instruments, he has succeeded, during the past month of May, in producing continuous and unbroken traces.

The following table gives a comparative view of the mean results of the autographic registers of the barograph and thermograph, and of the eye-readings of the standard barometer and shaded thermometers, recorded at the same hours. The standard barometer has the cistern about one foot higher than the barograph, and the standard thermometers are exposed under a shed open all round, while the bulbs of the thermograph are under a louvred penthouse against the north wall of the observatory :—

Comparative mean reduced readings of barograph and standard barometer in 1883.

1883.	STANDARD BAROMETER.					BAROGRAPH.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
January	30'046	30'110	29'981	30'045	30'046	30'025	30'101	29'972	30'041	30'035
February	29'964	'040	'904	29'975	29'971	29'954	'036	'901	29'974	29'966
March	'857	29'924	'790	'864	'859	'853	29'923	'790	'864	'858
April	'740	'792	'660	'744	'734	'731	'790	'657	'741	'730
May	'618	'666	'548	'632	'616	'613	'666	'545	'634	'615
June	'532	'566	'469	'552	'530	'524	'564	'463	'547	'525
July	'523	'557	'462	'547	'522	'515	'564	'465	'548	'523
August	'597	'641	'544	'629	'603	'584	'625	'528	'614	'588
September	'671	'723	'618	'707	'680	'670	'726	'617	'704	'679
October	'893	'936	'826	'893	'887	'887	'936	'822	'891	'884
November	'930	'982	'861	'935	'927	'924	'979	'858	'929	'923
December	30'062	30'128	30'007	30'076	30'068	30'051	30'121	30'001	30'071	30'061
Year	29'786	29'839	29'723	29'800	29'787	29'778	29'836	29'718	29'797	29'782

Comparative mean readings of the thermograph and dry bulb thermometer in the thermometer shed, in 1883.

1883.	THERMOMETER IN SHED.					THERMOGRAPH (DRY BULB).				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
January	54.9	68.3	74.9	60.0	64.5	56.3	67.0	73.6	60.7	64.4
February	59.4	70.7	77.8	63.7	67.9	60.4	69.7	76.5	64.6	67.8
March	69.8	80.5	87.4	75.0	78.2	70.9	79.9	86.8	75.3	78.2
April	76.1	87.0	91.5	79.6	83.6	77.4	87.0	92.0	79.9	84.1
May	80.1	88.7	91.0	82.6	85.6	81.0	89.4	91.7	83.4	86.4
June	79.8	86.2	86.8	81.1	83.5	80.7	87.1	87.4	81.7	84.2
July	79.4	84.1	84.7	80.7	82.2	80.1	84.8	85.6	81.4	83.0
August	79.1	84.0	83.6	80.5	81.8	79.8	84.6	84.5	81.1	82.5
September	79.1	84.2	84.6	80.5	82.1	79.7	84.7	85.5	81.1	82.8
October	74.3	83.4	85.9	77.2	80.2	75.2	82.9	85.8	77.9	80.5
November	61.9	74.8	79.4	65.4	70.4	62.9	73.7	78.5	66.2	70.3
December	54.9	65.7	71.9	58.3	62.7	56.1	64.8	70.9	59.2	62.8
Year	70.7	79.8	83.3	73.7	76.9	71.7	79.6	83.2	74.4	77.3

Comparative mean readings of the thermograph and wet bulb thermometer in the thermometer shed in 1883.

1883.	WET BULB IN SHED.					THERMOGRAPH (WET BULB).				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
January	53.9	60.3	61.4	57.5	58.3	54.2	59.5	61.3	57.6	58.2
February	57.2	61.1	62.4	60.2	60.2	57.6	60.8	62.6	60.6	60.4
March	68.0	71.1	70.4	71.5	70.3	68.5	71.4	71.2	71.0	70.5
April	74.7	80.3	81.1	76.1	78.1	74.9	78.7	78.4	75.7	76.9
May	77.9	80.6	80.6	78.5	79.4	78.3	81.6	81.7	78.8	80.1
June	78.1	80.3	80.1	78.0	79.1	79.0	81.1	80.8	78.7	79.9
July	77.9	79.9	80.1	78.7	79.2	78.5	80.4	80.9	79.2	79.8
August	77.7	79.5	79.5	78.3	78.8	78.1	80.2	80.3	78.7	79.3
September	77.9	79.5	79.6	78.6	78.9	78.3	80.2	80.4	79.0	79.5
October	72.7	75.6	75.5	74.4	74.6	73.3	75.7	76.1	75.2	75.1
November	59.2	64.5	65.1	62.1	62.7	60.3	64.5	65.8	62.9	63.4
December	52.9	58.2	60.3	56.2	56.9	54.0	57.9	60.0	56.4	57.1
Year	69.0	72.6	73.0	70.8	71.4	69.6	72.7	73.3	71.2	71.7

The sunshine recorder has been in constant use throughout the year, being placed on the top of the transit room building, in order to secure an unobstructed range of sky exposure. The instrument is shaded by some distant trees for about quarter hour after

sunrise and before sunset, but this is unavoidable. It is, however, of little importance, as, in the atmosphere of Calcutta, the rays that would reach the instrument during these intervals have but little heating power.

The observations of ground temperature have been steadily continued, the thermometers being read three times daily at intervals of eight hours. It has been mentioned in previous reports, that the temperature shown by the thermometer at 1 foot appeared anomalously low as compared with that of the surface on the one hand, and that of the 3 feet thermometer on the other. As a reverification of the instruments convinced me that the fault was not in the thermometer, I thought it probable that it might be due to convection within the wooden tube in which it was placed, and which left a considerable air space around the wooden block on which the instrument is mounted. To test this view, I had a second tube constructed of smaller diameter, so that by winding a strip of flannel around the instrument it nearly fitted the tube and prevented convection. This was buried side by side with the former tube, the thermometer bulb being at the same depth; and a comparison of the results, which have now been recorded more than a twelve month, has gone far to confirm my surmise. On the average of the year, the early morning reading of the new thermometer is 0.5° and the evening reading 0.3° in excess of that of the old thermometer, whereas the noon reading is 0.1° lower, indicating that, in the wide tube, the night temperature is considerably affected by the convective descent of cooled air from the upper and exposed end of the tube. This is not compensated by convection of the more heated air in the day time, as the latter, being lighter, tends to remain at the upper end of the tube.

One month before the close of the year under report, a thermometer was installed at a depth of 6 feet from the surface, the tube in this case being closed below by a copper plate, with a view to keeping out water in the rains. This is read once daily. The following table gives the mean monthly readings of all these thermometers:—

Mean temperature of ground at Alipore in 1883-84.

MONTHS.	SURFACE.			1 FOOT DEEP (OLD).			1 FOOT DEEP (NEW).			3 FEET DEEP.			6 FEET DEEP.	MEANS.				
	5½ hours.	13½ hours.	21½ hours.	5½ hours.	13½ hours.	21½ hours.	5½ hours.	13½ hours.	21½ hours.	5½ hours.	13½ hours.	21½ hours.	13½ hours.	Air in shade.	Sur- face.	1 foot deep (old).	1 foot deep (new).	3 feet deep.
April 1883	79.0	109.9	82.9	85.0	85.4	86.5	86.1	85.5	87.4	83.7	83.9	83.9	...	83.8	90.6	85.6	86.3	83.8
May "	82.9	110.9	86.1	88.7	89.0	90.4	89.4	89.1	91.4	87.0	87.1	87.1	...	86.1	93.3	89.4	90.0	87.1
June "	82.2	97.0	83.8	87.3	87.5	88.2	87.7	87.4	88.7	87.8	87.7	87.7	...	83.9	87.7	87.7	87.9	87.7
July "	81.5	95.0	83.4	86.0	85.9	86.4	86.1	85.6	86.6	86.2	86.3	86.3	...	82.8	86.6	86.1	86.1	86.3
August "	81.8	94.7	84.0	85.9	85.8	86.2	86.0	85.6	86.5	86.3	86.3	86.3	...	82.4	86.8	86.0	86.0	86.3
September "	81.4	96.6	83.3	86.2	86.2	86.7	86.3	85.9	86.8	86.6	86.5	86.6	...	82.7	87.1	86.4	86.3	86.6
October "	76.1	96.0	78.9	83.8	83.9	84.2	84.0	83.6	84.4	85.7	85.8	85.8	...	80.1	83.7	84.0	84.0	85.8
November "	62.3	83.3	65.6	74.7	75.0	75.3	75.4	75.0	75.9	79.9	80.7	80.5	...	69.8	70.4	75.0	75.4	80.4
December "	55.4	72.0	58.9	66.1	66.4	66.8	66.9	66.3	67.2	73.1	73.6	73.4	...	62.4	62.1	66.4	66.8	73.4
January 1884	56.1	73.9	59.9	66.3	66.4	67.2	66.8	66.1	67.3	70.2	70.7	70.7	...	64.1	63.3	66.6	66.7	70.5
February "	61.0	84.0	64.5	70.1	70.3	71.3	70.8	70.1	71.5	72.5	72.8	72.9	...	68.6	69.8	70.6	70.8	72.7
March "	73.3	100.8	77.6	81.1	81.1	82.4	81.4	80.7	82.3	79.6	79.7	79.8	77.7	81.2	83.9	81.5	81.5	79.7
Means	72.8	92.8	75.7	80.1	80.2	81.0	80.6	80.1	81.3	81.6	81.8	81.8	...	77.3	80.4	80.4	80.7	81.7

The hourly readings of the surface, 1 foot and 3 feet thermometers, recorded for one month, in each of the three principal seasons (the cold season, hot season, and the rains) in 1881 and 1882, show that there is no appreciable difference between the means of the three daily readings and the true daily means of any of the three thermometers, and, therefore, the former may be accepted as valid representatives of the latter. These exhibit the same features as those of previous years, the anomalous depression of the old 1 foot thermometer above noticed being due to foreign causes. The temperature at 3 feet is, on the average of the year, 1.3° higher than that of the ground surface, and 4.4° higher than that of the air. The temperature, shown by the new 1 foot thermometer, is 0.3° higher than that of the surface, and 1° lower than that at 3 feet, therefore intermediate, and implying a rapid downward increase of temperature, which yet remains for explanation.

The number of instruments verified at the Alipore observatory, during the year ending 31st March, 1884, is as follows:—

Instruments.								No.
1. Barometers	.	.	.	.	.	.	.	58
2. Aneroids	.	.	.	.	.	.	.	6
3. Dry and wet bulb thermometers	.	.	.	.	.	.	.	87
4. Maximum thermometers for air temperatures	.	.	.	.	.	.	.	42
5. Minimum do.	do.	do.	do.	.	.	.	.	61
6. Do.	do.	for nocturnal radiation	.	.	.	.	.	14
7. Solar radiation do.	.	.	.	.	.	.	.	16
8. Standard do.	.	.	.	.	.	.	.	2
9. Common do.	.	.	.	.	.	.	.	8
10. Sand glasses	.	.	.	.	.	.	.	80
TOTAL								<u>374</u>

and the following is a return of those received and issued by the Observatory Store Department:—

Instruments.								Received.	Issued.
1. Barometers	.	.	.	.	.	.	.	47	64
2. Aneroids	.	.	.	.	.	.	.	6	7
3. Dry and wet bulb thermometers	.	.	.	.	.	.	.	58	86
4. Maximum thermometers for air temperatures	.	.	.	.	.	.	.	21	57
5. Minimum do.	do.	do.	do.	.	.	.	.	49	59
6. Do.	do.	for nocturnal radiation	.	.	.	.	.	25	31
7. Standard do.	.	.	.	.	.	.	.	3	4
8. Solar radiation do.	.	.	.	.	.	.	.	32	14
9. Common do.	.	.	.	.	.	.	.	8	8
10. Anemometers	.	.	.	.	.	.	.	1	20
11. Anemoscopes	.	.	.	.	.	.	.	0	8
12. Six's thermometers	.	.	.	.	.	.	.	6	0
radiation thermometers	.	.	.	.	.	.	.	6	1
.	.	.	.	.	.	.	.	80	78
TOTAL								<u>342</u>	<u>437</u>

are considerably more than double the corresponding which is mainly due to the requirements of the twenty-two in Bengal for the purposes of the local system.

The time signals have worked in a far more satisfactory manner than in any previous year. Two time balls are dropped from the Alipore observatory, the one on the Semaphore Tower in Fort William, the other on the Port Commissioners' office on the Strand. The latter of these was under repair, and therefore out of work for 22 days. It dropped correctly on 264 days and failed on 1 only. The former was dropped correctly on 285 days and failed on 3 days, as shown in the tabular statement below.

A signal was given by either one or the other ball on 288 days, the remaining 78 days being either Sundays or public holidays.

Table showing the failures of the two time balls during the official year 1883-84.

Dates of failures.	Nature of failure.
5th June	Time ball on the Semaphore Tower, Fort William, failed altogether.
28th July	Time ball at the Port Commissioners' Office failed altogether.
3rd September	Time ball on the Semaphore Tower, Fort William, dropped a few seconds after I P. M.
14th September	Time ball on the Semaphore Tower, Fort William, failed altogether.

OTHER OBSERVATORIES IN BENGAL AND ASSAM.—The twenty-two new observatories, which have been established in Bengal for the purposes of the local system of daily weather reports, furnish only one set of observations daily, and are not at present included in the imperial system. These are enumerated in the note below.¹ Excluding these, there are in Bengal and Assam 21 observatories, in addition to that of Alipore, and these are classified as follows:—

Second Class.

Sibsagar.	Hazaribagh.	Cuttack.
Dhubri.	Saugor Island.	Chittagong.
Bankipore (Patna).		

Third Class.

Darjeeling (St. Paul's School).	Gya.	Dacca.
Purneah	Berhampore.	Silchar.
Durbhanga.	Burdwan.	False Point.
	Jessore.	

Fourth Class.

Calcutta (Chowringhee).	Demagiri.	Mongpo.
	Tura.	

¹ The observatories established for the system of daily local report in Bengal are the following:—

Balasore.	Furreedpore.	Motihari.
Midnapore.	Mymensingh.	Buxar.
Ranigunge.	Rampore Beaulah.	Arrah.
Noakhally.	Dinajpore.	Dehree.
Burrisaul.	Rungpore.	Nya Doomka.
Serajgunge.	Julpigoree.	Ranchi.
Commillah.	Bhagulpore.	Chyebassa.
	Chupra.	

In Mr. Eliot's Report (Appendix A), are given the names of the superintendents and observers at all the second and third class stations, and at Demagiri and Tura. The Chowringhee observatory is attached to the Meteorological Office, the clerks of which record the observations, and Mongpo is included in the list of those which report direct to the Office of the Reporter General (Appendix E). Of the second class observatories, Mr. Eliot has inspected Sibsagar, Dhubri, and Bankipore, and I accompanied him on his visits to the two first stations, partly with a view to gaining some personal acquaintance with the physiography of Assam, which is peculiar, and a knowledge of which is requisite to the understanding of certain peculiarities in the local meteorology. Both the Assam observatories were found to be in a condition very creditable to the observers; the more creditable in the case of Sibsagar, that this observatory has never been visited previously by any Meteorological Officer. Certain of the arrangements were susceptible of some improvement, but these were such as could only be judged of by an expert. The barometer cistern was cleaned, and the thermometers reverified by comparison with a portable standard, and found to be virtually unchanged. Some further details of the results of the inspection are given in Mr. Eliot's Report.

The Bankipore (Patna) observatory, visited by Mr. Eliot alone, is also reported to be satisfactory.

Of the third class observatories, Silchar was inspected by myself, Darjeeling, Jessore, Gya, and Durbhanga by Mr. Eliot, and Dacca by the head clerk of the Bengal Meteorological Office. The Silchar observatory was more satisfactory than it had been found to be on previous occasions of its inspection, and the faults observed, such as the too great size and faulty construction of the thermometer shed, and the rickety and unsafe condition of the anemometer and wind vane posts, are hardly chargeable on the observer. He did not indeed set his barometer very accurately, but this was partly due to the oxidized condition of the mercury in the cistern. With the exception of one of the minimum thermometers, the instruments were in good condition. The barometer and thermometers were reverified.

Silchar is the only observatory that has been supplied with the full set of seismic instruments, as noticed in the first part of this report. These had just been set up at the time of my visit, and I was therefore enabled to ascertain the exact azimuth of the observatory, and to give the observer some instruction in the use of the apparatus.

Gya and Durbhanga are unfavourably reported on, and do not furnish observations that can be accepted as trustworthy. The observations do not harmonise with those of other stations around, and it is scarcely open to doubt that the discrepancies are due to ignorance or carelessness.

Dacca has been visited by the head clerk of the Bengal Office, and its condition is not favourably reported on, several of the instruments being in a very dirty condition.

The return of instruments, broken or injured, at the observatories of Bengal, given later on in this report, speaks favourably for the general carefulness of the observers.

Self-recording anemographs are at work at Darjeeling, Dhubri, Hazaribagh, Chittagong, Saugor Island, and Cuttack, as well as at the Alipore observatory. As in previous years, the Beckley's anemographs in use at Alipore, Saugor Island, and Chittagong are far more satisfactory in their working than the Casella's anemographs at the other stations.

The following observers have been awarded special allowances during the current year, the name marked* being that of an observer now placed on the list for the first time and † indicating that the allowance has been raised from Rs. 5 to Rs. 10.

Names.	Stations.	Amounts. Rs.
Makhadaprosad Chowdhry	Burdwan	10
Mahendranath Roy	Berhampore	10
† Dandadhar Datta Barua	Sibsagar	10
Maniruddeen Ahmed	Dhubri	10
J. Alley	Cuttack	5
* Nathoo Lall	Hazareebagh	5

That allotted last year to Jogin Chunder Banerjee, the observer of Durbhanga, has been withdrawn.

One object of my visit to Assam was to decide on the site of the new observatory which has been sanctioned for the Assam Valley. The station of Gauhati had been originally proposed for the purpose, but was unfavourably reported on by the local officer, as being surrounded by hills. This objection proving to be well founded, Tezpur was proposed as the alternative, and an inspection of this station having proved that it is well fitted for the purpose, a site was selected on the summit of a small hill overlooking the river Brahmaputra.

I also visited Shillong, partly to inspect the seismic apparatus lately set up there, and partly to see how far it would be practicable to establish an electrical wind vane and anemometer on the summit of the Shillong ridge, to register the direction and movement of the wind across the highest part of the Khasi hills, and transmit their indications to an observatory which I propose to establish in Shillong. I find that this can be done by telegraph wires about two miles in length, and as the register will be one of very great importance, I only await the receipt of the instruments ordered some time since from England, to take further steps for establishing this observatory.

OBSERVATORIES IN THE NORTH-WESTERN PROVINCES AND OUDH.—Except that the observatory, established on the voluntary system at Pauri, ceased to contribute registers after November 1883, the observatories in these provinces were the same as in the previous year, *viz.* :—

Second Class.

Allahabad.	Lucknow.
Agra	Roorkee.

Third Class.

Chakrata.	Dehra (Forest School).	Benares.
Ranikhet.	Bareilly.	Jhansi.
Mussooree (St. Fidelis).	Meerut.	Pauri.
Mussooree (S. G. Office).	Gorakhpur.	Pithoragarh.
Dehra (S. G. Office).	Ghaziipur.	

Dr. Murray Thomson's report (Appendix B) gives the names of the superintendents and observers at all except the Mussooree observatories and the Forest School at Dehra. Also the results of his inspection of Roorkee, Chakrata, and Meerut (the only observatories inspected), and of an unofficial visit to Lucknow and the St. Fidelis's observatory. The Allahabad observatory, being attached to the Reporter's Office, is constantly under his eye.

In consequence of the final determination of the North-Western Provinces Government, not to establish the future 1st class observatory in connection with the Muir College, Allahabad, the comparative observations of temperature and humidity that have been carried on on that site, for the last two years, were discontinued at the end of the year under report, and the instruments have been withdrawn. The results of the two years observations are noticed in the report (Appendix B), from which it appears that the mean temperature of the College site is nearly 1° higher than that of the present observatory, and the diurnal range of temperature greater; except in the spring months, March to May. These differences are greatest in October. They confirm the conclusion drawn from the results of the Chowringhee and Alipore observatories in Calcutta, *viz.*, that whatever care be taken to render the exposure of the instruments uniform, a mere change of the site of an observatory, from one part to another of the same station, induces such a change in the average indications of the instruments, that no comparison of any value can be made between the registers, unless, by means of simultaneous registration, the effects of the change of site have been ascertained and can be eliminated.

The work of the Agra observer is unfavourably reported on, and that of the voluntary observer at St. Fidelis's School, Mussooree, still more so. As little control can be exercised over observers whose work is unremunerated, it is under consideration whether it will be better to place the observatory on the usual footing of a Government observatory and to pay the observer, on the condition of his furnishing trustworthy work, or to withdraw the instruments and close the observatory. Enquiries are being made with a view to the decision. With one temporary exception, the other observatories in the province are satisfactory.

Special allowances have been awarded for the current year to the following observers :—

Names.	Stations.	Amounts, R.
Chotay Lall	Lucknow	10
Kadernath Chatterjee	Allahabad	10
Jewa Nand	Ranikhet	10
Mir Altaf Ali	Agra	5
Saligram	Chakrata	5
Chirungi Lall	Roorkee	5
Devakinandan Pathak	Benares	5

The list of recipients is the same as that for the previous year.

OBSERVATORIES IN THE PUNJAB.—An additional observatory has been established in this province, *viz.*, in the Himalayan district of Kulu, at Kailang in the Chandra Bhaga valley, at an elevation of 10,000 feet above the sea-level, and the following is a complete list of the observatories of the province (not including Kashmir).

Second Class.
Lahore.

Third Class.

Mooltan.	Murree.	Kailang.
Dera Ismail Khan.	Sialkot.	Delhi.
Peshawar.	Ludhiana.	Sirsa.
Rawalpindi.	Simla.	

Kailang having been established with the special object of contributing current information on the meteorology of the mountain zone, and especially of the snowfall, reports

immediately to the general office for India; the remaining stations to the Meteorological Reporter to the Punjab Government. The names of the superintendents and observers at these latter are given in Dr. Lawrie's Report (Appendix C). Those of the Kailang observatory in Appendix E.

The observatories of Ludhiana, Simla, Delhi, and Sialkot were inspected by Dr. Lawrie, and those of Rawalpindi and Murree by myself shortly after the close of the year. The former are stated to have been found in excellent order, and the general work of the observatories to be very satisfactory. The observatory of Rawalpindi was for some years the most unsatisfactory in the province, the barometric observations, more particularly, being quite untrustworthy. Since the appointment of the present observer in November 1882, there has been a very great improvement, and during the past year, the Rawalpindi registers have been quite equal to the majority of those furnished by stations of the same class. I found the instruments in a very satisfactory condition as far as this depended on the observer, and as he could not have had any previous notice of my proposed visit, I do not doubt that such is their ordinary state.

The Murree observatory has always been favourably reported on, and its work is excellent. Indeed, the object of my visit was rather to gain an acquaintance with the position of the observatory and the local circumstances affecting the instruments than because an inspection was particularly needed. I availed myself of the opportunity to clean the barometer cisterns, both of the Rawalpindi and Murree instruments, both of which had become somewhat deteriorated with long use. Subsequently, I visited the Lahore observatory and cleaned the barometer there also.

The Lahore observatory is still at the Mayo Hospital, but its removal is urgently desired by the medical authorities; and however objectionable, as a rule, is the removal of an observatory from a site it has long occupied, in the present case it is desirable owing to the unsuitable circumstances of the present situation. But it is extremely important that the removal be made once for all, and that the future site be one that may be regarded as permanent. The chief object of my visit to Lahore was to see if this could be arranged, and I have given the results of my enquiry in the first part of this report.

The following is the list of the observers to whom special allowances have been awarded during the current year :—

Names.	Stations.	Amounts. R
Jaspat Rai	Lahore	5
Devan Chand	"	5
Fazul Rahman	Sirsa	5
W. Cruikshank	Murree	5
Khasi Ram	Pashawar	5
Wahid Ali	Mooltan	5

OBSERVATORIES IN THE CENTRAL PROVINCES.—As in previous years, these are eleven in number, *viz.*:—

Second Class.

Nagpur.		Jubbulpore.		Pachmarhi.
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Third Class.

Saugor.		Khandwa.		Raipur.
Hoshangabad.		Chanda.		Sambalpur.
Seoni.		Sironcha.		

The names of the superintendents and observers are given in Appendix D. The Sanitary Commissioner to the Government of the Central Provinces, who exercises the local administration of the observatories, reports favourably of the observers, with the exception of the Saugor observer, Tado Rao, who absconded in March, leaving the work of the observatory for a few days in abeyance. A new barometer room has been provided at the Khandwa observatory and the barometer was moved into it on the 1st July; and at Sambalpur the observatory has been moved to a new site, the barometric observations being however still carried on at the former site for the purpose of ascertaining the amount of change in the normal values that are the consequence of the removal.

The Sanitary Commissioner has inspected the Seoni observatory and found everything in good order.

The following observers have been selected for special allowances during the current year, the sign * indicating that the present is the first time of award :—

Names.	Stations.	Amounts.
		R
T. V. Allaghi Swami	Nagpur	10
Jadunath Bose	Hoshangabad	5
Shamsoonder Dass	Sambalpur	5
Krishna Rao*	Raipur	5
Seetaram	Chanda	5
Pancham	Seoni	5

OBSERVATORIES IN BERAR.—As in the previous years, there were five of these observatories, *viz.*, four of the third and one of the fourth class; the last established by the Forest Department, and worked without charge to the Meteorological Department, except for the supply of instruments.

Third Class.

Akola.	Chikalda.
Buldana.	Amraoti.

Fourth Class.

Makhla.

The names of the superintendents and observers of the first four are given in the return appended to Mr. Pearson's Report, Appendix F. Those of Makhla are given in Appendix E. The four third class observatories are under the general direction of the Sanitary Commissioner for Berar, conjointly with the Reporter for Western India, and transmit their registers to the Bombay Meteorological Office.

No special mention is made of the work of these observatories in Mr. Pearson's report, and it does not appear that they have been inspected by the Reporter during the past year. The barometric registers of Chikalda and Buldana no longer show the discrepancies noticed in the previous year, and, as far as can be judged, the work of all these observatories appears to be satisfactory.

The following observers have had special allowances granted to them for the current year, that newly awarded being indicated by an* :—

Names.	Stations.	Amount.
		Rs.
Samuel Gregory	Akola	10
Bukaram Pandurang	Amraoti	5
Hira Lal *	Chikalda	5

OBSERVATORIES IN CENTRAL INDIA AND RAJPUTANA.—The number of these observatories also, is the same as in the previous year. The list is as follows:—

First Class.

Jeypore.

Third Class.

Sutna.	Indore.	Ajmere.
Nowgong.	Mount Abu.	Sambhar.
Neemuch.	Pachbudra.	Bickaneer.

The Maharajah's observatory at Jeypore is independent of this Department, except that it sometimes receives assistance and information, and on the other hand furnishes full copies of the registers to this office. Dr. Owen, who during the past year has superintended the observatory, has furnished a brief report on its condition and working, which is appended to that of the Reporter to the Government of the North-Western Provinces (Appendix B II). A nephoscope and sun-shine recorder have been added to the instruments recorded at the observatory, the latter having been in operation since the 1st February 1884. Dr. Owen notices some difficulties that have been met with in the working of the Van Rysselberghe meteorograph, and how they have been met and overcome.

Of the remaining observatories, Sutna, Nowgong, Ajmere, and Sambhar send their registers to the Meteorological Reporter for the North-Western Provinces and Oudh, and are under that officer's administration; those of Indore, Neemuch, Mount Abu, and Bickaneer report to the Meteorological Reporter for Western India, and Pachbudra to the Central Office in Calcutta. The names of the superintendents and observers will accordingly be found respectively in the lists (Appendices B III, F II and E). The first mentioned of these officers has not inspected any of the observatories during the past year, and no special mention is made of them in his report. Those of Mount Abu, Neemuch and Indore have been visited by Mr. Pearson, whose remarks on the results of his inspection will be found in Appendix F.

At Mount Abu, the barometer was out of order and untrustworthy, but this does not appear to be due to any negligence on the part of the observer. With one exception, which, however, does seem to imply neglect of the instructions, the other instruments were in good order. The observer's work is generally well reported of.

At Neemuch some faults are noticed in the arrangement and exposure of the instruments, and their condition was by no means satisfactory. In some other respects also, the observer's work is unfavourably noticed, and he is said to be deficient in intelligence. As a special allowance was awarded to him two years since on the recommendation of Mr. F. Chambers, it has not been withdrawn, but will be so unless his work during the present year shows very great improvement.

At Indore the instruments were in good order. The observer is said to be an intelligent man, but apparently somewhat careless.

There has been a considerable improvement in the work of the Pachbudra observatory, but the registers cannot as yet be called satisfactory. Special allowances have been awarded to the following observers during the current year:—

Names.	Stations.	Amounts. Rs.
Ram Lall †	Bickaneer	10
Har Nath	Sutna	5
Ram Prosad	Ajmere	5
T. Bachu	Neemuch	5

OBSERVATORIES IN THE BOMBAY PRESIDENCY.—These are fourteen in number, as in the previous years ; the first class observatory of Colaba being under management independent of the Meteorological Department.

First Class.

Colaba (Bombay).

Second Class.

Belgaum.

Poona.

Deesa.

Kurrachee.

Third Class.

Jacobabad.

Hyderabad (Sind).

Bhuj.

Rajkot.

Sholapur.

Surat.

Malegaon.

Ratnagiri.

Karwar.

The names of the superintendents and observers are given in Appendix F II.

The four stations of the second class have all been inspected by Mr. Pearson during the year. At Kurrachee the instruments were found to be in good condition and call for no special remark. At Deesa the majority were in good order. Some of the mechanical arrangements of the observatory were defective, and Mr. Pearson reports that there had been some difficulty in obtaining an assistant observer, Deesa being nothing but a military camp and (the native inhabitants presumably) very backward in point of education. At Poona, with one exception, the instruments were in good condition, but the apparently ineradicable habit of observing time other than that of the station was still persevered in. The Casella anemograph is more favourably reported on than is the case at most stations.

At Belgaum everything was found to be on the whole satisfactory.

Of the third class stations, Jacobabad, Hyderabad, Bhuj, Surat, Malegaon, Ratnagiri, Sholapur, and Karwar were inspected during the year ; all therefore with the exception of Rajkot. The results are given in detail in Mr. Pearson's Report (Appendix F). The observers of Hyderabad and Karwar are very favourably reported on. Those of other observatories fairly well more or less, with the exception of the man in charge of the anemometer at Hyderabad and the late observer at Malegaon, Solomon Aaron, whose work is stated to have been very defective. At Jacobabad the nocturnal radiation thermometer had been improperly exposed ; at Bhuj the mercury of the barometer cistern was thickly encrusted with oxide, the thermometer had too large an opening for ventilation and the rain gauge had been tarred ; the anemometer post too was not easy to ascend. At Surat the wind observations were very roughly made and the observer's punctuality was doubtful. The anemometer also was out of order. At Malegaon the barometer was dirty but not otherwise out of order, and the apparently discrepant character of the observations during the past three or four years, to which the attention of the Reporter had been drawn, must therefore have been due to some fault of the observer. The anemometer was worn and worked stiffly. At Ratnagiri everything was in good order, except that the anemograph tower was not weather proof. At Sholapur the observatory is retained at its old side. It had been proposed to remove it to the Electric Telegraph Office, and arrangements were in progress for this purpose, but the step has been postponed, as it is doubtful whether the Electric Telegraph Office will long be retained at its

present site. The barometric readings during a part of December were incorrect and had to be rejected. At Karwar every thing was in good condition; this has hitherto been a voluntary observatory, but application having lately been made for an allowance to the observer, and granted, it will henceforth rank on the regular list of Government observatories under the Department.

The following is the list of observers in the Bombay Presidency to whom special allowances have been awarded for the current year :—

Names.	Stations.	Amounts. Rs.
Mahadev Cuddum	Ratnagiri	5
Narayan Sakaram	Poona	5

OBSERVATORIES IN MADRAS, MYSORE, COORG, AND HYDERABAD.—Of the three additional observatories in Madras, sanctioned in October 1881, that of Kurnool was established in 1882, that of Cuddapah a few days before the close of the year under report, *viz.*, in March 1884, and the third only since its expiration. There were therefore eighteen observatories in these provinces in 1883-84, of which three were of the second class, *viz.* :—

Second Class.

Vizagapatam. | Bellary. | Trichinopoly.

Third Class.

Gopalpore.	Madras.	Madura.
Masulipatam.	Bangalore.	Cochin.
Secunderabad.	Negapatam.	Wellington.
Kurnool.	Salem.	Mercara.
Cuddapah.	Coimbatore.	Mangalore.

With the exception of Vizagapatam, which is the private observatory of Mr. A. V. Nursingrow, and Gopalpore, which was established for the purposes of the Bengal system of storm-warnings, all the above are under the administration of the Meteorological Reporter to the Government of Madras, extracts from whose report are given in Appendix G. A nominal list of the superintendents and observers is also appended (G II).

Miss Pogson reports that three of the observatories, *viz.*, Bellary, Cuddapah, and Secunderabad, were inspected by her during the past year. The Bellary observatory was found to be in fair condition, although susceptible of improvement in many points of detail, and complaint is made of great delay in the transmission of the registers to the Madras Office. Cuddapah being a newly established observatory, nothing can be said as to the work of the observer. The position is reported to be good, and the general arrangements satisfactory. The general condition of the Secunderabad observatory was found to be very satisfactory and highly creditable both to the superintendent and the observer, and it is remarked that this observatory, formerly the worst, now ranks as one of the best in the Presidency.

Of the second class observatory at Trichinopoly, complaint is made of "the obstinacy of the assistants" in not forwarding their reduced registers till many months after they are due. It does not appear, however, that recourse has been had to any other means of enforcing obedience than simple remonstrance, which could be ignored with impunity. The only other observatory at which the observer has given serious cause for complaint is Masulipatam. Under the direction of this office, this man was reduced to

half pay in March last, but even this measure has failed to bring about any improvement, and his further services will be dispensed with shortly. The barometric returns of this station have long been untrustworthy, but it is uncertain whether this is not due to some accidental injury suffered by the instrument in transport. At Cochin the anemometric registers are quite valueless, which appears to be due, partly at least, to the faulty position of the anemometer.

At the remaining observatories there has been nothing calling for remark. Miss Pogson reports that their general work has been satisfactory during the year, and that there has been much improvement in the work of reducing the observations, which is required of all observers who draw the high rate of salary sanctioned for the old observatories in Madras, but in no other part of India.

OBSERVATORIES IN BRITISH BURMA.—The observatories in British Burma are eight in number, as in previous years, *viz.*, Akyab under the general direction of the Bengal Reporter, and noticed in his report; Diamond Island under the Central Office, and the remaining six enumerated in the following list under the immediate direction of the Sanitary Commissioner of British Burma.

Second Class.

Rangoon.

Third Class.

Bassein.	Thytmio.	Toung-hoo.
Diamond Island.	Mergui.	Moulmein.
Akyab.		

Lists of the superintendents and observers during the past year are given in Appendices A, E, and H I.

The report of the Sanitary Commissioner on the condition of his observatories is given in Appendix H. He has inspected all of the six observatories under his local administration, and found them to be generally in satisfactory condition. Rangoon during the greater part of the year sent up registers as full of errors as in the previous year. The errors were, however, chiefly in the computation of the results. The observational work, if not quite satisfactory, appears from such tests as can be applied, less open to condemnation.

No special reference is made to the work of the Akyab observatory in Mr. Eliot's report, and it may therefore be inferred that he has no reason to repeat the unfavourable remarks made in his report of the previous year. The observatory of Diamond Island, which like that of Akyab is attached to the Electric Telegraph Office, has worked satisfactorily as far as can be judged from the registers.

The observatories of Bassein, Thytmio, and Toung-hoo have been better during the past year, but the barometric observations of the last two have been frequently of doubtful validity and do not appear to accord with those of other observatories. The site of the Toung-hoo observatory has been changed during the year. The barometer at Moulmein appears in some months to be unduly low.

The majority of the Burmese observatories have generally ranked below those of other Provinces. Whether this be due to the fact of an inferior class of men being appointed as observers in Burma, or to other causes, it is difficult to say. But the fact is unquestionable.

A special allowance has been continued to the only observer in the Province who has been found deserving of it, *viz.*:—

Name.	Station.	Amount. Rs.
P. H. Hilbert	Moulmein	5

OBSERVATORIES AT THE BAY ISLANDS.—These, as in former years, are two, *viz.*:—

Third Class.

Port Blair (Andamans). | Nancowry (Nicobars).

The names of superintendents and observers are given in Appendix E.

Port Blair has worked satisfactorily during the past year. It is extremely important, owing to its proximity to the cyclone cradle, and, as was shown on a recent occasion, might be of much greater utility were it in telegraphic connection with the Indian mainland, as information could then be obtained of the formation of cyclones one or two days, and in some cases probably three or four days, earlier than at present. Nancowry furnished unsatisfactory registers during the first half of the year under report, and it became necessary to withhold a portion of the allowance, but since September the work has been satisfactory.

The special allowance awarded during the last two years has been continued to—

Name.	Station.	Amount. Rs.
J. F. Peters.	Port Blair.	5

EXTRA INDIAN OBSERVATORIES.—An addition has been made to the working extra Indian observatories during the past year, in that established at Victoria in the Island Mahé of the Seychelles. They are now eight in number, *viz.*:

Second Class.

Leh. | Aden. | Zanzibar.

Third Class.

Bushire.	|	Amini Divi (Lakhadives).
Quetta.	|	Mahé (Seychelles).
Katmandu.	|	

The names of the superintendents and observers are given in Appendix E, with the exception of those of Leh, which should be included in the list of the Punjab stations, and those of Zanzibar, which appear in the list accompanying the report of the Reporter for Western India.

The work of the observatories of Zanzibar and the Seychelles has already been noticed in the first part of this report, also the unsatisfactory results of the Amini Divi observatory, which is controlled by the Meteorological Reporter to the Madras Government.

The Leh observatory is not particularly mentioned in the Punjab report (Appendix C), but I have reason to believe that it has continued to work as satisfactorily as in previous years. I regret to learn that the Assistant Observer Bhola, whose excellent work under Dr. Scully in Yarkand has been prominently noticed in the publications of the Meteoro-

logical Office, has lost his appointment at the Leh observatory owing to his prolonged absence without leave. The meteorological observatory at this station remains independent of the actinometric observatory, which commenced work in November 1883, but it was left under the general superintendence of the Actinometric Observer, Sergeant Rowland, throughout the past winter, during the absence of the British Joint Commissioner.

The work of the Katmandu observatory has not been satisfactory. For several months in succession the registers had to be returned for correction, and owing to the observer's neglect of official instructions, some portions have had to be rejected as valueless.

The Aden observatory has hardly been so good as in previous years. The superintendent has found it difficult, if not impracticable, to obtain a competent observer at the rate of pay which is found sufficient in India, and it is now proposed to reduce Aden to a third class observatory, in which case the observations can be taken by the head clerk of the superintendent's office.

The Quetta registers have been satisfactory, as far as can be judged from internal evidence.

INSTRUMENTS.

In Appendix I, is given a return of the instruments in store at the beginning of the year, and of those received and issued by the Calcutta Meteorological Office, and includes the stock, receipts and issues of the Alipore observatory; and in Appendix K is a return of the instruments issued to each observatory. In this are incorporated the returns furnished by the local Reporters.

METEOROLOGICAL OFFICES AND OFFICE WORK.

The general control of the meteorological observatories and offices in the different provinces, with the local exceptions noticed in the foregoing sections, has been in the hands of the following officers during the year.

Name.	Office.	Provinces.
John Eliot, M.A. A. Pedler, Esq. (Offg.)	Meteorological Reporter to the Government of Bengal	Bengal and Assam.
S. A. Hill, B.Sc. Dr. Murray Thomson (Offg.)	Meteorological Reporter, North-Western Provinces and Oudh	{ North-Western Provinces, Oudh, Rajputana, and Central India (part).
Dr. E. Lawrie	Meteorological Reporter, Government of Punjab	Punjab and Kashmir.
A. N. Pearson, Esq. (Offg.)	Meteorological Reporter for Western India	Bombay, Berar, Rajputana, and Central India (part).
Miss Isis Pogson	Meteorological Reporter to Government of Madras	Madras, Mysore, and Hyderabad.
Dr. W. Watson Dr. J. H. Loch	Sanitary Commissioner, Central Provinces	Central Provinces.
Dr. Little	Sanitary Commissioner, Berar	Berar.
Dr. D. Sinclair	Sanitary Commissioner, British Burma	Burma.
Surgeon J. Reid	Senior Medical Officer, Bay Settlements	Andamans and Nicobars.

Mr. Eliot was absent on privilege leave during the months of August, September, and October, during which Mr. Pedler officiated as Meteorological Reporter to the Government of Bengal.

Mr. S. A. Hill left on furlough on the 20th May 1883, making over the charge of his office to Dr. Murray Thomson, who officiated up to the end of the year.

Mr. F. Chambers returned from leave on the 6th June, and took over charge of his appointment from Mr. Pearson; but on the 18th idem, having been appointed to officiate as Superintendent of the Colaba observatory, Mr. Pearson resumed the Reportership for Western India, and continued in that charge till the close of the year under report.

In the Punjab and Madras the permanent incumbents remained in charge of their respective offices.

The following table shows the number of stations, the registers of which were sent to each of the reporters respectively for reduction and verification during the year under report:—

PROVINCES.	METEOROLOGICAL REPORTERS.						TOTAL.
	India.	Bengal.	North-Western Provinces and Oudh.	Punjab.	Western India.	Madras.	
Bengal and Assam	3	19	...	...	...	...	22
North-Western Provinces and Oudh .	1	15	...	...	...	...	16
Punjab	1	...	...	11	...	...	12
Rajputana and Central India . . .	1	...	4	...	4	...	9
Central Provinces	11	...	...	...	...	...	11
Berar	1	...	...	...	4	...	5
Bombay . . . . .	...	...	...	...	13	...	13
Madras, Mysore, and Coorg . . .	1	1	...	...	...	15	17
Burma	7	1	...	...	...	...	8
Bay Islands	2	...	...	...	...	...	2
Extra Indian	6	...	...	...	1	1	8
TOTAL	34	21	19	11	22	16	123

This list does not include the registers of the Colaba observatory and of Jeypore, which are furnished to the Meteorological Office with all the necessary reductions with a partial exception in the case of Colaba. The observatory at Goa only sends telegraphic reports.

In Bengal, the North-Western Provinces, and in Bombay (partly) the Reporters superintend the rainfall registers of the district and subdivisional stations of their respective provinces, and prepare weekly and monthly returns of the rainfall, *viz.*:—

	Stations.
Bengal	167
North-Western Provinces and Oudh	253
Bombay (partially) over	400

The Bengal and Bombay Reporters also administer a system of storm warnings for the protection of the local ports ; and the Bengal Reporter has had during the last year, in addition to the above, the working of the system of daily telegraphic weather reports (from the 15th May to the 15th November), which has already been noticed in the first part of this report. He also administers that department of the Central Office which deals with the current meteorology of the Bay of Bengal, and collects the meteorological observations from the log-books of ships entering the Port of Calcutta.

Mr. Dallas, Assistant Meteorological Reporter to the Government of India, has continued in charge of the Imperial system of daily weather reports, which, during the last year, were issued at Simla from the 16th May to the 15th November, and at Calcutta up to 15th May and from the 16th November to the 31st March. He also prepared monthly and semi-annual summaries of the weather reports, and is engaged in the reduction of the marine observations received from the London Meteorological Office, and in the preparation of weather charts of the Bay of Bengal, and the sea southward as far as the equator. The charts showing the barometric pressure and the wind directions for the first eight months of the year are now complete.

OFFICE ESTABLISHMENT.—The following is a return of the number of permanent employés in the offices of the several Meteorological Reporters :—

	India.	Bengal.	North- Western Provinces.	Punjab.	Western India.	Madras.	TOTAL.
Head Clerks	1	1	1	1	1	1	6
Computers	3	...	...	...	1	...	4
Clerks and Copyists	3	2	1	2	...	3	11
Tabulators	18*	7	4	...	5	...	34
Draughtsmen	3	1	...	...	...	...	4
Artisans . . . . .	...	3	...	...	...	...	3
Peons and Menials	10	4	2	1	2	1	20

The Central Office has remained under the charge of the Head Clerk, Babu Fanindra Mohun Basu, during the past year, and, I am glad to report, with the same satisfactory results as in previous years. The head clerk of the Bengal Meteorological Office, Babu Chandi Churn Chatterji, is reported by Mr. Eliot to be a most efficient head clerk. The Meteorological Reporter for the Punjab also speaks well of the services of the chief observer and head clerk of his office, Jasput Rai.

Four tabulators and a draughtsman were added to the Bengal Office at the beginning of the year under report, for the purposes of the provincial system of daily weather report ; and three or four clerks had to be entertained temporarily, in addition to the above, from the 15th May to the 15th November. One man has been added to each of

* Besides these, there are four temporary clerks for reducing the London Meteorological Office marine logs,

the offices of the Reporters to the Governments of the North-Western Provinces, the Punjab, and Madras.

WEATHER BULLETINS AND STORM SIGNAL SERVICE.—The daily weather reports of the Imperial office were issued at Simla from the 16th May to the 15th November, and at Calcutta during the remainder of the year. They now give the 10 A.M. observations of the principal meteorological elements of 96 stations, together with the maximum and minimum temperatures, the average wind movement, the rainfall and the general weather of the preceding 24 hours; and, in the rainy season, the rainfall of 28 additional stations. The tabulated observations, with general remarks on the weather of the day, are sent to press at 5 P.M. daily, and the printed sheets are distributed on the following morning. The verbal summary is telegraphed at 5 P.M. daily to the seats of the Provincial Governments, and copies are sent to the Allahabad and Calcutta newspapers.

An independent provincial system of daily weather reports, giving the observations at 10 A.M. of 31 stations, was organised at the beginning of the past year by the Meteorological Reporter to the Government of Bengal, at the cost of the Local Government. It is in operation from the 15th May to the 15th November. The telegrams are received as urgent, and the daily report, including a verbal description of the weather, is sent to the Bengal Secretariat Press at 4 P.M. daily, and printed and distributed from the press in time for the evening mails. A full description of the working of this system is given in Mr. Eliot's report (Appendix A).

The Bengal system of daily weather reports, based on telegrams received as "urgent" from 17 stations around the coasts of Bay of the Bengal, which forms part of the storm warning service, is independent of the above. This is carried on throughout the year, the daily bulletin, illustrated by a chart of the Bay, being lithographed in the office and distributed by peons or through the afternoon post.

The past year was a stormy year at the head of the Bay of Bengal, not less than ten storms being recorded in Mr Eliot's report. They were all small storms, and with the exception of the second on the list, *viz.*, that of June 26th to July 4th, did not appear to warrant the hoisting of the storm signals.

The working of the storm signal service of the Bombay coasts is noticed in Mr. Pearson's report (Appendix F). The daily reports of the ten stations which transmit telegrams are not printed for the Bombay Meteorological Office, but a manuscript copy is posted at the office and another sent to the *Times of India*, and an abstract to the Bombay Gazette. Only one storm occurred during the year, of sufficient importance to justify the hoisting of the storm signals, *viz.*, the same storm for which the signals were hoisted in Bengal. This storm crossed the peninsula, its daily progress being reported in the Simla weather reports, and also telegraphed from Simla to Bombay. The working of the Bombay system has been expedited by connecting the Meteorological Office with the Telegraph Office by telephone.

WEEKLY, MONTHLY, AND SEMI-ANNUAL REPORTS.—From May to October, both inclusive, a monthly descriptive summary of the chief weather characteristics of the month, based on the telegraphic reports, was prepared in the Simla Office, and published in the Gazette; and in May and November, a general summary of the Indian meteoro-

logy of the preceding six months was drawn up and published in like manner. Appended to the summary of the six months November 1882 to April 1883, published in the *Gazette of India* on the 2nd June, was a note in which, after adverting to the distribution and amount of the Himalayan snows in the preceding winter and spring, the conclusion was announced that if the views "that an unusual extent and thickness of snow on the Himalaya is productive of dry north-west and west winds in India are valid, we must be prepared for a long spell of dry weather and a retarded rainfall in the Upper Provinces." This is the first time that the office has ventured to base a prediction on the facts of the snowfall, or indeed on any other foundation than a general resemblance of the weather of the earlier months of the year to that of the corresponding season of some previous year. The result was therefore awaited with much interest. This result was given in a note appended to the next semi-annual weather report, published in November. It was not in exact accordance with the terms of the above forecast, inasmuch as the setting in of the rains in the Upper Provinces took place only a few days later than on the average, and rather more than a fortnight of rainy weather preceded the period of drought, which had been foreseen, and which set in on the 19th July. After this date, the north-west current, which had existed throughout at no great height above the hills of the outer Himalaya, "descended and replaced the monsoon, prevailing over the whole of North-Western India and Rajputana, and influencing the winds, even down to the Deccan on the south and to Behar on the east." The final conclusion was drawn that "the experience of the present season has given strong confirmation of the validity of the view on which the forecast was based." Some further notice of this subject has already been given in Part I of this report.

In Bengal, a weekly meteorological and rainfall statement has been published by the Reporter, and also a monthly meteorological and rainfall statement, giving the averages of 44 observatories, and a complete statement of the daily rainfall during the month, at 166 rain-gauge stations. Both these periodical issues are accompanied by a full verbal description of the general results.

No mention is made in Dr. Murray Thomson's report of the periodical publications of the North-Western Provinces Office, probably because they were of the same character as in preceding years.

In Bombay, monthly abstracts of the results of the observatories have been published in the Government Gazette as in previous years.

ANNUAL REPORTS.—The report on the meteorology of the year 1882 was complete, and in the printer's hands before the end of December 1883, and it was submitted to Government in its complete form on the 14th July 1884. The printing of the text was completed in April, but the issue was again delayed by the preparation of the plates, a delay which was extended by the loss of the set first prepared by the draughtsman, and the consequent necessity of reproducing them.

The report gives tables of temperature for 130 stations, and rainfall returns of 457 stations, being a decrease of one of the former, and an increase of 40 of the latter, on the numbers respectively given in the report of the previous year, in the corresponding tables. The returns of pressure, wind direction and other meteorological elements are nearly as numerous as those of temperature. The elements tabulated in the Appendices are as

follow. I give for comparison the number of registers summarised in the corresponding tables of the reports of the four previous years :—

	NUMBER OF STATIONS.				
	1878.	1879.	1880.	1881.	1882.
Equilibrium temperatures of solar radiation	99	106	109	106	112
Temperature of nocturnal radiation	97	100	108	106	104
Temperature of the ground . . . . .	...	...	2	4	4
Mean and extreme air temperatures	116	123	126	131	130
Sea-level equivalents of mean temperature	100	101	105	108	108
Means and extremes of atmospheric pressure	113	119	122	125	124
Sea-level equivalents of mean atmospheric pressure	96	98	105	107	108
Direction and movement of winds	113	118	124	127	125
Temperature of evaporation	106	111	115	121	120
Tension of atmospheric vapour	113	120	123	128	127
Mean relative humidity	114	120	123	128	127
Mean proportion of clouded sky	110	118	122	125	124
Inches of rainfall in each month	253	365	399	417	457
Number of days on which rainfall was measured	276	365	379	403	457

The descriptive letter press discusses the chief characteristics of the meteorology of the year. It includes 27 numbered tables, giving the average values of all the more important elements, for all stations that have furnished returns for three years and upwards; and the report is illustrated with 8 plates, of which one is a chart showing the position of all Indian observatories and raingauge stations; three, in coloured lithography, represent the average distribution of temperature, pressure and winds in each month of the year; and the remainder illustrate particular phases of weather, *viz.*, certain instances of rainfall in the cold weather; the progress of a monsoon storm across Bengal; the conditions accompanying a break in the rains in August; and the progress of a cyclone in October. This last has been made the subject of a detailed investigation, the results of which have been embodied in a memoir by Mr. Eliot which is now in the press.

The original observations of six observatories, *viz.*, Calcutta, Lucknow, Lahore, Nagpur, Bombay, and Madras, were issued as a distinct publication in monthly parts, and form a small quarto volume, the fourth of the series, which was issued in a complete form in October 1883. Those for 1883, the fifth volume of the series, was issued in May 1884.

A report on the rainfall of the North-Western Provinces in 1883, was compiled in the Office of the Meteorological Reporter for the North-Western Provinces, and published in the Government Gazette of the 29th March last; and one on the meteorology of the North-Western Provinces in 1882-83 was prepared by Mr. S. A. Hill and printed and distributed before his departure on leave.

Mr. Pearson also prepared a brief sketch of the meteorology of the Bombay Presidency in 1882-83.

MISCELLANEOUS PUBLICATIONS.—Part II of the second volume of the Indian Meteorological Memoirs was issued in November 1883. It contains a memoir by myself on the storms of the west coast and on the land formed cyclone of Gujarat of July 1881, and a very important paper by Mr. Hill on the normal temperature of Northern India, illustrated by a series of isothermal charts for the year and for each month.

Another publication of the office is the chart of the average rainfall of India, which has been already noticed in the Administration Report for last year, and briefly in Part I of the present report.

A paper was communicated to the March meeting of the Asiatic Society of Bengal on the "Theory of the cold weather rains of Northern India," and will shortly be published in the Society's Journal; and another paper "On the connection of the Himalayan snowfall with dry winds and seasons of drought in India" was read before the meeting of the Royal Society on the 1st May 1884.

Dr. Murray Thomson mentions the preparation of a new edition of Mr. Hill's paper (published in 1879). "On the rainfall of the North-Western Provinces and Oudh," and Mr. Pearson that of a paper communicated to the Royal Meteorological Society of London on "Some results of an examination of the barometric variation in Western India."

Appendix L gives a list of the Government officials, libraries, observatories, societies, &c., to which the publications of this office are presented, including those which send their own publications in exchange.

LIBRARY.

The library is contained in six large double book-cases, and is in excellent condition; but owing to the want of space in the office, the book-cases are sufficient only for the preservation of the books. Any systematic arrangement, according to subject-matter, is impossible; and the book-cases are distributed in different parts of the office building. It will be impossible to effect a proper re-arrangement, and to render the library useful for general reference, until the office is removed to a much larger building.

A list of the additions to the library is given in Appendix M.

HENRY F. BLANFORD,

Meteorological Reporter to the Government of India.

SIMLA:

The 22nd July 1884.

APPENDIX A.

Extracts from the Administration Report of the Meteorological Reporter to the Government of Bengal for the year 1883-84.

THE Bengal Meteorological Department was under my control during the whole of the past official year, except the months of August, September, and October, when I was absent on privilege leave. Mr. Alexander Pedler, who had acted previously for me on four occasions, was again appointed to officiate as Meteorological Reporter during my absence.

During the past year, the extensions of the Bengal Meteorological Department, which were proposed and sanctioned during the preceding year, and the character, extent, and scope of which were stated in my Administration Report for the year 1882-83, were completely and successfully effected. The past year has hence been one of considerable importance in the working of this department, and it seems desirable to place on record a statement of the manner in which the proposed extensions were carried into effect during the year.

The proposals which were finally sanctioned in March 1883 by the Government of India, at the request of the Government of Bengal, authorised and provided for a number of changes, of which the following were the most important :—

1st.—The establishment of a large number of additional stations, recording observations at 10 A.M. only, to be distributed throughout the province in such a way as to give a fairly complete view of all the more important meteorological changes in the province.

2nd.—Provision for additional inspection of the observatories at all seasons of the year, so that the source of any error in the observations detected by the examination of the returns sent to the office might be immediately traced, if necessary, by a visit of an inspecting officer to the observatory. By this means errors, whether due to instrumental changes, or to carelessness, or ignorance, or other defects on the part of the observer, might be speedily rectified, and the accumulation of inaccurate observations prevented.

3rd.—Special arrangements for the speedy and continuous transmission of the meteorological and rainfall observations taken throughout the province, day by day, to the Bengal Meteorological Office, where they may be at once reduced and tabulated, and the various meteorological returns be prepared for publication without any unnecessary delay.

4th.—The publication of daily weather reports for the province of Bengal during the south-west monsoon, or from May 15th to November 15th, and of weekly and monthly meteorological and rainfall returns in the *Calcutta Gazette*, with short summaries giving the more important features of the weather and rainfall for the period in question, and their distribution to district officers and certain officers in the Irrigation, Public Works, and other departments.

5th.—An increase in the number of clerks in the Bengal Meteorological Office in order to enable the additional work to be performed fully, accurately, and rapidly. A considerable increase was necessary, in order not merely to deal with the larger number of observations transmitted to this office, in consequence of the increased number of observatories, but also to bring up and to maintain the whole of the office work up to date, and to go through the whole of the observations taken at the older established stations, and obtain daily and weekly means of the elements of meteorological observation, in order to enable the peculiarities of the weather for any period in discussion to be stated quantitatively as deviations from the normal or average conditions for that period.

The scheme in its final and complete form was submitted by the Government of Bengal to the Government of India on the 29th January, 1883, and sanction was granted by the Government of

India on terms which were accepted by the Government of Bengal. These terms were in effect that the Bengal Government should contribute a sum from its provincial funds equal to the estimated cost of the extensions to the Imperial Meteorological grant, and that the money should be expended in carrying out the proposals of the Government of Bengal, but that the control and supervision of the additional observatories should be exercised by the Meteorological Reporter to the Government of India. The effect of this is that the whole of the observatories now established in Bengal are, as before, subject to the control and orders of the Imperial Reporter, and the working of every part of the system is under his supervision. This arrangement has been perfectly satisfactory during the past year. It has secured on the one hand the extension of the department, which was considered essential by the Government of Bengal, whilst it has maintained uniformity of system and control by a single head—most important features in a scientific department, such as a Meteorological Department is or ought to be.

Establishment of additional observatories.—The stations at which it was finally decided to establish observatories were as follows :—

Orissa	Balasore.
South-West Bengal	{ Midnapore. Ranigunge.
East Bengal	{ Noakholly. Burrisaul. Serajgunge. Commillah. Furreedpore. Mymensigh.
North Bengal	{ Rampore Beaulah. Dinagapore. Rungpore. Julpigoree.
Behar	{ Bhagulpore. Chupra. Motihari. Buxar. Arrah. Dehree.
Sonthal Pergunnahs and Chutia Nagpur	{ Nya Doomka. Ranchi Chyebassa.

It was originally intended to establish and work these observatories entirely through the agency of the Public Works Department, but this was found to be in a few cases (*viz.*, Serajgunge, Chyebassa, Ranigunge, and Nya Doomka) impracticable.

As soon as the letter of the Government of India sanctioning the proposals was received (March 15th, 1883), instructions were issued by the Secretary to the Government of Bengal, Public Works Department, to the Executive Engineers in whose divisions the stations selected for observatories were situated, requesting them to choose sites and arrange for the early construction of sheds and the selection of suitable officers in the establishment of the Public Works to take the observations. Copies of plans of the pattern thermometer shed approved and adopted by the Meteorological Reporter to the Government of India were sent, and a few rules for guidance in the selection of a suitable site. It was originally intended to commence the work of observation under the new system from the 1st of April, but this was, of course, not possible, in consequence of the sanction of the scheme by the Government of India not being received until nearly the end of March. As early erection of the sheds and the establishment of the observatories was an imperative necessity, in order to commence the publication of the Bengal Daily Weather Reports on the 15th May, it was

necessary to leave the selection of sites entirely to the judgment of the Executive Engineers or their subordinates. In the great majority of cases very suitable sites were chosen, and the sheds erected as rapidly as could be expected under the circumstances. In one or two cases unexpected difficulties arose in obtaining well exposed sites, the local authorities opposing the erection of the shed. In one case, the Executive Engineer, after the shed had been built on a suitable site, was ordered by the Commissioner of the Division to take it down and re-erect it on a distant and much more objectionable site.

The following table gives the dates on which observations were first taken and transmitted to the Bengal Meteorological Office at the newly established observatories :—

METEOROLOGICAL DIVISION.	Station.	Date of commencement.
ORISSA	Balasore	22nd May 1883.
SOUTH-WEST BENGAL	Midnapore	1st June "
	Ranigunge	10th June "
EAST BENGAL	Noakholly	3rd August "
	Burrisaul	2nd July "
	Serajunge	4th August "
	Commillah	1st June "
	Furreedpore	5th July "
	Mymensingh	18th June "
NORTH BENGAL	Rampore Beaulcah	27th August "
	Dinagepore	20th May "
	Rungpore	22nd May "
	Julpigoree	15th May "
BEHAR	Bhagulpore	4th June "
	Chupra	8th June "
	Motihari	30th May "
	Buxar	3rd June "
	Arrah	21st July "
	Dehree	4th June "
SONTHAL PERGUNNAHS AND CHUTIA NAGPUR.	Nya Doomka	5th July "
	Ranchi	11th July "
	Chyebassa	21st August "

Inspection of observatories.—This is, as I have frequently pointed out, of the utmost importance, in order to secure continuous accuracy of observation. It is the one part of my duties as Provincial Reporter which I can only perform during the cold weather vacation. In consequence of the changes in the college vacations recently introduced, I shall have less opportunity than previously of inspecting observatories. I proposed last year that an inspecting officer should be sanctioned, who should perform the combined duties of draughtsman and inspecting officer. A passed student was

obtained from the Thomason Engineering College, Roorkee. It was, however, found that his time was so fully occupied with the preparation of the ordinary and the additional rainfall charts (which I submitted to the Government during the course of the south-west monsoon), that it became necessary to propose another arrangement. Advantage was taken of his transfer to the Office of the Executive Engineer, Cawnpore, to appoint a draughtsman on a slightly lower salary, and I applied to Government to sanction the transference of the amount saved to increase the pay of the head clerk, on condition that he assisted me in the work of inspection. This arrangement was approved by Government. As it is inconvenient for both the head clerk and myself to be absent at the same time, I was only able to take him with me on inspection to a single observatory. After the termination of my cold weather vacation, I sent him to inspect the observatories in Eastern Bengal. He did this in so efficient a manner, as to fully satisfy me of his ability and capacity to perform the duties of inspecting officer. He will thus in future be of valuable assistance, and enable me to secure the inspection of any observatory at any time that it may seem necessary or desirable.

The work of inspection during the past year was almost entirely confined to the cold weather period—November to March. The amount of inspection done will show the value of this new arrangement. The following stations were inspected by myself :—

Station.	Dates.	Station.	Dates.
Dhubri . .	December, 14th and 15th.	Bhagulpore . .	November, 17th and 18th.
Gauhati . .	ditto, 27th and 28th.	Chupra . .	December, 5th and 6th.
Tezpur . .	ditto, 24th.	Durbhunga . .	November, 20th.
Sibsagar . .	ditto, 20th to 22nd.	Nya Doomka . .	ditto, 26th.
Rungpore . .	January, 2nd, 1884.	Buxar . .	December, 7th.
Darjeeling . .	ditto, 4th.	Arrah . .	ditto, 4th and 5th.
Julpigoree . .	ditto, 6th.	Ranigunge . .	ditto, 2nd and 3rd, and
Patna . .	November, 23rd.		June, 23rd and 24th.
Motihari . .	ditto, 21st and 22nd.		

and the following by my head clerk :—

Station.	Dates.	Station.	Dates.
Julpigoree . .	January, 6th.	Furreedpore . .	February, 16th.
Dinagepore . .	ditto, 8th.	Burrisaul . .	January, 31st, and February, 1st.
Rampore Beaulah . .	ditto, 10th and 11th.	Commillah . .	February, 9th.
Serajunge . .	February, 20th, 21st, and 22nd.	Noakholly . .	ditto, 6th.
Mymensingh . .	ditto, 25th, 26th, and 27th.	Gya . .	March, 25th and 26th.
Dacca . .	ditto, 13th.	Dehree . .	ditto, 22nd.

Arrangements for transmission of the observations to the Central Office.—The methods I proposed to employ for the regular transmission of the meteorological and rainfall observations were given in the last Administration Report.

The 10 A.M. observations, taken at the various meteorological stations, are forwarded daily to the office in various ways, according to the position of the observatory with respect to telegraphic and postal communication and the purposes for which the observations are utilized.

Urgent telegrams are sent daily throughout the whole year by the following stations. These are required for the Bay of Bengal Weather Report :—

Saugor Island.	Dacca.	Cuttack.
Balasore.	Chittagong.	False Point.

Similar telegrams are also sent by the following stations which are not in Bengal :—

Diamond Island.	Vizagapatam.	Madras.
Akyab.	Coconada.	Nagapatam.
Gopalpore.	Masulipatam.	Trincomalee.
	Galle.	

The following stations send urgent or ordinary telegrams during the period, 15th May to 15th November, when the 10 A.M. observations are required for the compilation of the Bengal Weather Report :—

Mymensingh.	Durbhunga.	Bhagulpore.
Commillah.	Motihari.	Patna.
Serajunge.	Chuprah.	Arrah.
Rungpore.	Midnapur.	Buxar.
Dinagepore.	Burdwan.	Dehree.
Julpigoree.	Ranigunge.	Gya.
Darjeeling.	Jessore.	Hazaribagh.
Purneah.	Rampur Beaulah.	

The remaining observatories are at stations to which telegraphic communication has not yet been extended; hence they can only transmit their observations by post. These are—

Ranchi.	Burrisaul.	Furreedpore.
Chyebassa.	Noakholly.	Berhampore.
	Nya Doomka.	

Those stations, which forward weather telegrams, also transmit by post copies of the observations sent by telegraph, so that errors, due to transmission, are eliminated before the determination of the weekly and monthly averages for publication in the Gazette, and the entry of the reduced observations in the volumes of records in which they are filed. In the case of the Imperial observatories this is done by means of Form B, supplied by the India Meteorological Office, and at the provincial or newly established observatories by means of postal cards. These are despatched daily by the first post after the time of observation.

The non-telegraphing provincial third class observatories forward their observations daily by means of post-cards. During the past year, they have, almost without exception, transmitted the observations regularly, and have thus enabled me to publish the weekly meteorological returns in a complete form.

The only station, the name of which appears in the weekly meteorological forms, but which fails to send in its observations in time, is Demagiri. This, however, is not an observatory maintained by Government, but a voluntary observatory, started in 1881 by the medical officer.

The rainfall observations at the 166 rainfall-recording stations are forwarded mainly by postal cards daily or weekly.

If rain falls during any day, the amount is entered in a postal card, Form C, and sent off by the first dāk leaving the station after the hour of observation (6 P.M.) for Calcutta. The returns of actual rainfall are, by this means, forwarded immediately after occurrence. As returns are occasionally lost, all stations are also required to send a weekly return on a postal card giving the amounts (nil or otherwise) of the rain on each day of the preceding week. This is useful as a check on the daily returns as received, and also as confirming the non-occurrence of rainfall during any week, which otherwise would be indicated only by the non-arrival of daily post-cards.

The number of postal card forms supplied to the observatories during the year was—

	Number.
Form G for meteorological observations	9,450
„ C for daily rainfall	50,662
„ D for weekly rainfall	12,994

A few stations are so situated that postal communication is very slow, and the returns for the last day of the week and the weekly return itself would invariably be received too late for inclusion in the weekly rainfall report. In these cases, special arrangements were made for the transmission of the weekly returns by dāk to the nearest telegraphic offices, from which they are telegraphed to Calcutta.

The rainfall stations which report weekly in this manner are—

Jamalpore.	Ruma.	Pooree.
False Point.	Sorah.	Cox's Bazar.
Saugor Island.	Jellasure.	Bhola.
Rangamati.	Jagatsingpore.	Palamow.
	Barripada.	

The arrangements are thus somewhat complex and required some time to effect. However, the great majority of the officers co-operated most heartily, and the changes were made on the whole with less trouble and much greater readiness than I expected.

Publication of Returns.—The frequent publication of meteorological statements giving the latest possible information was one of the most important features of the sanctioned extensions. This was carried out during the past year by the publication of—

1st.—The Bengal Weather Report from the 15th of May until the 6th November. When the extended system was fully established, telegrams giving the 10 A.M. observations were received daily from 31 stations in the province. These were reduced and tabulated as they arrived. The whole of each day's telegrams were received and the observations tabulated ready for the press by 3-30 P.M. daily. A brief summary was then written, describing in words the salient features and peculiarities of the weather of the previous 24 hours, and the whole sent off at 4 P.M. to the Bengal Secretariat Press, where it was printed in time for distribution to district officers by the mail of that evening. The work of distributing the report was done entirely by the Bengal Secretariat Press.

2nd.—A weekly meteorological and rainfall statement. The first part of this gives the average and extreme values of the elements of meteorological observations at all the observatories of the province for the week, and of the average district rainfall for the week, and its variation from the normal rainfall for the week. The second part gives the amount of the rainfall, day by day, for the preceding week, at each of the 166 sub-divisional and rainfall-recording stations, the total rainfall of the week, of the month up to date, and of the total rainfall from 15th May up to date, with corresponding normal or average amounts for comparison. A summary is added directing attention to the more important features of the meteorology for the week, more especially the distribution of rainfall. This return is published in the *Calcutta Gazette* every Wednesday morning, and gives the meteorological and rainfall observations for the week preceding the previous Friday evening.

3rd.—A monthly meteorological and rainfall statement, published usually during the second week of each month, and giving averages of the observations taken at the 44 observatories during the preceding month, a complete statement of the daily rainfall during the month at the 166 rainfall-recording or sub-divisional stations, and a summary giving the characteristics of the meteorology of the province during the previous month, and its more important points of difference from the normal weather of the period, and a brief analysis of the distribution of rainfall over the province during the month.

Preparation of daily averages.—The only other point which it appears necessary to describe was the method adopted to obtain the daily and weekly averages of the barometric height, maximum and minimum temperature, and rainfall required for the comparative statements and columns in the daily and weekly weather reports. The only averages hitherto obtained and used in the office were monthly averages. The reduced observations were recorded on large forms, each form containing the observations at a single station for a month, and the averages of these observations. This was a sufficient and satisfactory mode of preserving the observations, so long as all that was required was the preparation of monthly averages for the India Meteorological Office and for publication in the *Calcutta Gazette*.

The record of the observations in monthly sheets was on the other hand extremely inconvenient for the calculation of daily and weekly averages. It was hence found necessary to copy them into books specially prepared, so that the observations for the same day of the year might be found in the same column. These books thus contain a systematic record of the elements of observation to which they refer, and enable the average values of those elements of observation at any of the meteorological stations to be immediately determined for a day, week, or any other short period. The tabulation of the results in this way has also the further advantage of enabling the highest and

lowest values of the elements of observation at any meteorological station recorded since the establishment of the observatory at that station for any period of the year to be immediately ascertained.

Last year the 10 A.M. barometric readings, the maximum and minimum in shade temperatures, and the rainfall observations taken at the eighteen observatories that have been established for some years in the province, were copied from the monthly sheets into four large folio volumes, which will form the permanent record of these observations in future. If the strength of my office enable me to do it, I hope during the present year to have the humidity, cloud and wind amount tabulated in the same manner, when it will be possible to compare all the elements of observation (except wind direction) at 10 A.M. on any day of the year with the corresponding mean values for that day.

The rainfall observations at all the sub-divisional stations (160 in number) preserved in the office were also collected together and tabulated in the same manner, and the daily and weekly means obtained. These are the actual means and are employed for comparison in the weekly reports. The rainfall returns for each station will continue to be added, so that the twenty-four folio volumes which contain these observations will form the permanent record of the rainfall of the province.

Position of new observatories.—The following table giving the latitude, longitude, and elevation of the level of the mercury in the barometer cistern, so far as this has been ascertained at the additional observatories, is added:—

Latitudes, Longitudes, and Elevations of the Provincial Third Class Meteorological Observatories.

Meteorological Division.	Station.	Latitude.	Longitude.	Elevation in feet above mean sea level.	Level determined.	How determined.	Authority for elevation.
Orissa	Balasore . . .	21° 30' 12"	86° 58' 16"	56'15	Barometer cistern at observatory.	Levelled to G. T. S. B. M. at False Point.	Executive Engineer.
South-West Bengal.	Midnapore . . .	22° 15' 33"	87° 21' 45"	148'38	Barometer cistern at the Executive Engineer's Office.	Levelled to S. B. M.	Ditto ditto.
	Ranigunge . . .	25° 51' 40"	87° 57' 55"	?			
	Noakhelly . . .	22° 48'	91° 6'	38'59	Barometer cistern on the 1st floor of the circuit-house.	Levelled to B. M. Chittagong Railway Survey.	Ditto ditto.
East Bengal	Burrisaul . . .	21° 41' 40"	90° 24' 30"	?			
	Serajunge . . .	24° 26' 38"	89° 47'	?			
	Comillah . . .	23° 28'	91° 14'	34'74	Ditto ditto	Ditto ditto	Ditto ditto.
	Furadpore . . .	23° 36'	89° 52'	?			
	Mymensingh . . .	24° 45' 13"	90° 27' 21"	?			
North Bengal	Rampore Beaulah . . .	24° 22' 5"	88° 38' 55"	71'97			
	Dinagpore . . .	25° 38'	88° 40' 46"	117'92	Barometer cistern	Levelled to G. T. S. B. M.	Assistant Engineer, Julpigoree Division.
	Rungpore . . .	25° 44' 55"	89° 17' 40"	123'00	Ditto ditto	Ditto ditto	Ditto ditto.
	Julpigoree . . .	26° 32' 20"	88° 45' 38"	283'70	Ditto ditto	Ditto ditto	Ditto ditto.
	Bhagulpore . . .	26° 10'	83° 52'	160'18	Ditto ditto	Levelled to G. T. S. B. M. on Bhagulpore Church.	
Behar	Chupra . . .	25° 46' 42"	84° 46' 45"	?	?		
	Motihari . . .	26° 39' 46"	84° 57' 29"	223'6	Barometer cistern	By spirit levelling from G. T. S. B. M.	Sub-Overseer, P. W. Dept.
	Buxar . . .	25° 34' 24"	84° 0' 46"	239'22			
	Arrah . . .	25° 33' 46"	84° 42' 22"	192'82	Barometer cistern, Superintendent Engineer's room.	Levelled to G. T. S. B. M. at Railway Station.	P. W. Dept.
	Dehree . . .	24° 54' 30"	84° 12' 30"	351'14	Barometer cistern in dispensary.	Ditto ditto.	
Sonthal Pegunahs and Chutia Nagpore.	Nya Doomka . . .	24° 16'	87° 17' 30"	?			
	Ranchi . . .	23° 22' 37"	85° 22' 6"	2,128'14	Barometer cistern	Levelled to G. T. S. B. M. on the doorway of the Lutheran Church at Ranchi.	Overseer, P. W. Dept.
	Chyebassa . . .	22° 32' 50"	85° 50' 57"	?			

Second class observatories.—These are, as last year, seven in number, of which five are in Bengal and two in Assam. The following table gives the superintendents and observers at these observatories during the year:—

STATIONS,	Superintendents,	Superintendent's allowance,	Observers,	Observer's allowance,	Assistant Observers,	Assistant Observer's allowance,
		Rs.		Rs.		Rs.
Sibsagar	Dr. R. M. Meiklejohn ¹ . „ T. D. O'Partridge ² .	30	Baboo Dandadhor Dutt Barua.*	30	Baboo Ratneswar Gogoi.	10
Dhubri	Surgeon J. Mullane ³ . Assistant Surgeon Atul Chandra Rai. ⁴ Surgeon Edwin Dobson ⁵ }	30	Munshi Moniruddin Ahmed.†	30	Kadimuddin ⁶ . Baboo Andia Prosad De. ⁷	10
Hazaribagh	„ R. Cobb .	30	Baboo Nathoo Lal	30	Dwarkanath .	10
Bankipore	„ T. G. French .	30	Munshi Mohubbut Lal.	30	Mudden Mahunlal	10
Saugor Island	Nil . . .	...	Mr. A. J. Moth ⁸ . „ C. Williams ⁹ . „ S. Holge ¹⁰ . „ J. A. Thomas ¹¹ . „ S. Holge ¹² . „ C. Williams ¹³ . „ J. A. Thomas ¹⁴ .	45	..... ..... Nil.	
Cuttack	Nil . . .	...	„ J. C. Smith ^{15†} . „ H. W. Alley ¹⁷ }	32	Mr. H. W. Alley* ¹⁶ . Mr. B. Sebastian ¹⁸ }	13
Chittagong	Nil . . .	...	„ P. O. Pereira .	30	„ J. Dias ¹⁹ . „ F. X. Derajo ²⁰	15

¹ From 1st April to 6th September 1883.

² „ 7th September 1883 to 31st March 1884.

³ „ 1st April to 18th August 1883.

⁴ „ 19th August to 3rd November 1883.

⁵ „ 4th November 1883 to 31st March 1884.

⁶ „ 1st April to 6th October 1883.

⁷ „ 7th October 1883 to 31st March 1884.

⁸ „ 1st April to 1st June.

⁹ „ 2nd June to 14th June 1883.

¹⁰ „ 15th June to 14th August 1883.

¹¹ „ 15th August to 31st October 1883.

¹² „ 1st November to 24th November 1883.

¹³ From 25th November to 30th November 1883.

¹⁴ „ 1st December 1883 to 31st March 1884.

¹⁵ „ 1st to 15th April and 20th July to 6th December 1883.

¹⁶ „ 1st to 15th April and 20th July to 6th December 1883.

¹⁷ „ 16th April to 19th July 1883 and 7th December 1883 to 31st March 1884.

¹⁸ „ 16th April to 19th July 1883 and 7th December 1883 to 31st March 1884.

¹⁹ „ 1st to 22nd April and 23rd July to 31st March (was on privilege leave).

²⁰ „ 23rd April to 22nd July 1883.

* Received special allowance of Rs. 5 per month for good services.

† Received special allowance of Rs. 10 per month for meritorious services.

Five of these observatories, *viz.*, Dhubri, Hazaribagh, Cuttack, Chittagong, and Saugor Island self-registering anemographs. At the three first named stations the anemographs are of the *lla* pattern, which record the wind direction and amount at intervals of one hour. The remaining stations—Saugor Island and Chittagong—are provided with Beckley's anemographs, which

register wind direction and amount continuously. There were several breaks exceeding 24 hours in the working of these instruments, the dates of which are given in the following table :—

STATIONS.	Dates of commencement of work.	Periods during which instrument was out of order during 1883-84.
Dhubri	18th March 1882	From October 26th 8 A.M. to 27th 5 P.M.
Hazaribagh	15th April 1880	Nil.
Cuttack	11th April 1879	September 18th to 19th and December 16th to 18th.
Chittagong	20th June 1879	May 21st to 23rd, June 9th to 10th, July 11th to 13th.
Saugor Island	9th February 1880	May 21st to 23rd, October 25th to 27th.

Three of these observatories were visited during the cold weather, *viz.*, Dhubri, Sibsagar, and Bankipore.

Dhubri Observatory—Was inspected on the 14th and 15th of December 1883. No change of importance has been made in the position of the shed or the arrangement of the instruments since my last inspection in March 1882. The anemograph tower was erected shortly after that visit, and is situated on a fairly open site near to the thermometer shed. The tower is well built and in good repair. The barometer is kept in the lower room. The recording part of the anemograph is placed on a table in the upper room of the floor, which is by no means so steady and rigid as it ought to be for such an instrument. The observer is, however, very careful in looking after it, and has made one or two slight additions which not only show his interest in it, but which improve, to some extent, the working of the instrument. The anemograph and barometer were both found to be in very good order. The barometer was also cleaned in order to free it from the large amount of oxidized mercury which had formed in the cistern.

The thermometer shed was in good order. The instruments were clean and in very satisfactory condition. The observatory continues to maintain its high character, and is thoroughly satisfactory in character and accurate and valuable in its observations.

Sibsagar Observatory—Was inspected on 20th to 22nd December 1883 for the first time since its establishment in 1874. The station is situated at a distance of about nine miles to the south of the Brahmaputra in a flat open district. Much of the country between the station and the river is covered with cane jungle. To the south of the station, at a distance of over 20 miles, the Naga Hills rise up to a height of 2,000 to 6,500 feet and form a very marked feature. The Himalayas, the nearest snow peaks of which are at a distance of 70 miles, are also very distinctly visible in clear weather. The station itself is built on the banks of a very large square tank, about two miles in perimeter, the level of the water of which is about 20 feet above that of the adjacent country. The banks, supporting and containing this water, are very wide and large. The observatory is situated on ground formerly occupied by the civil jail on the eastern bank of the tank. The shed is unfortunately placed on the edge of the bank where it begins to slope down to a large shallow excavation, from which the earth was removed to form part of the bank, and is now filled with water. It is also shut in between two buildings (detached portions of the old jail), one of which is used by the observer as his residence, and the other as an office. This second or northern building contains the barometer. This instrument was placed in good light and was in good order, except that the surface of the mercury was oxidized. This was removed. The thermometers were tested and were all in good order. The shed was in fair condition. It was surrounded by a bamboo fence. The observer was requested to cut down several shrubs and high grass which interfered to some slight extent with the free circulation of the air in the shed. The anemometer and wind-vane are placed on the roof of the building containing the barometer, to which access is given by a strong iron ladder. They were in good order. The only defect was that the anemometer was screwed to the top of a long iron rod fixed on the roof, and hence oscillated to some extent with the motion of the air. The observer was instructed to have a small brick pillar built and the anemometer fastened to a shorter rod, the lower end of

which is to be buried in the brick pillar. The observer is very neat, careful, and accurate in his work, and the observatory in thoroughly good order. The observer deserves much credit for this, more especially as the station has hitherto been beyond the range of inspection by the Bengal Meteorological Office.

Bankipore—Was inspected on the 23rd of November 1883. No change has been made in the observatory since my last visit. It was found to be in the same satisfactory condition as last year.

Imperial Third Class Observatories.—These are 15 in number. Ten are situated in Bengal, one (Akyab) in Burmah, two (Silchar and in connection Tura) in Assam, and two (Gopalpore and Coconada) in Madras. The two last are maintained in connection with the Bay of Bengal Weather Service.

The following table records the superintendents and observers at these observatories during the year 1883-84 :—

STATIONS.	Superintendents.	Observers.	Observer's allowance.
			Rs.
Darjeeling, St. Paul's School.	R. Carter, Esq., Rector, St. Paul's School, Darjeeling	Mr. W. Moore	25
Purneah	Dr. Picachy	{ Baboo Rasick Lal Bose ¹ „ Rajanikanta Chackervarti ²	15
Durbhanga	„ W. A. Gilligan	„ Jogin Chunder Banerji. *	
Gya	{ „ R. McLeod ³ Baboo Benod Kishen Bose ⁴	{ Lala Nowrungee Lal	15
Berhampore	{ Surgeon S. M. Shircore ⁵ Surgeon-Major F. C. Nicholson ⁶	{ Baboo Mohendra Nath Roy †	15
Burdwan	{ „ H. B. Purvis ⁷ „ Cameron ⁸ „ R. D. Murray ⁹	{ „ Mokhada Persad Chowdhry †	15
Jessore	{ „ D. W. D. Commins ¹⁰ Asst. Surgeon Behary Lal Pal ¹¹ Surgeon E. Bovill ¹²	{ Baboo Poresh Nath Roy Chowdhry ¹³ „ Urjoon Mahanty ¹⁴	15
Dacca . . . . .	.....	{ Mr. J. S. David ¹⁵ „ T. W. DeSouza ¹⁶ Baboo P. C. Bose ¹⁷	15

¹ 1st April to 31st May 1883 (transferred).

² 1st June 1883 to 31st March 1884.

³ 1st April to 15th October 1883, and 23rd November to 31st March 1884.

⁴ 16th October to 22nd November 1883.

⁵ 1st April to 20th August and 21st November to 31st March 1884.

⁶ 21st August to 20th November 1883.

⁷ 1st April to 15th August 1883, and 1st to 14th January 1884.

⁸ 7th August to 31st December 1883.

15th January to 31st March 1884.

¹⁰ 1st April to 4th October, and 29th November to 31st March 1884.

¹¹ 5th October to 9th November 1883.

¹² 10th to 28th November 1883.

¹³ 1st April 1883 to 6th February 1884, and from 20th February to 31st March 1884.

¹⁴ 7th to 19th February 1884.

¹⁵ 1st to 24th April 1883.

¹⁶ 25th April to 21st December 1883, and 4th January to 31st March 1884.

¹⁷ 22nd December 1883 to 3rd January 1884.

* Special allowances of Rs. 5 a month stopped for six months from January 1884 for neglect of duties.

† Received a special allowance of Rs. 10 a month for meritorious service.

STATIONS.	Superintendents.	Observers.	Observer's allowance.
Silchar	Dr. J. J. Monteith ¹⁸ „ A. H. Whitewell ¹⁹	Baboo Romes Chandra Bhuddra	Rs. 15
Demagiri	Nil	Asst. Surgeon Suryya Kumar Ghose	Nil.
False Point	Nil	Mr. E. Workman ²⁰ „ J. London ²¹	25
Akyab	Nil	„ H. J. Smythe „ R. J. Keys „ H. Vetricano	15
Tura	Civil Medical Officer	Civil Hospital Assistant	Voluntary station.
Gopalpore	Mr. A. L. Taylor, Port Officer	Mr. Goom Appala Narainhar	15
Coconada	Captain F. M. Gillham, Master Attendant	„ C. T. M. Gaetane	15

I was unable to inspect the majority of these observatories during the cold weather college vacation, which was fully occupied in visiting the Assam stations and the new or provincial third class observatories. Durbhunga, Gya, Darjeeling, and Jessore were visited, by myself; Silchar by Mr. Blandford, Meteorological Reporter to the Government of India; and Dacca by my head clerk. The majority of these observatories are satisfactory in character, and the observations accurate and reliable. Two of them, I regret to state, although slightly improved, do not yet furnish observations upon which I am able to place implicit confidence. The observations sent in do not harmonize with those of the neighbouring stations, and the only possible inference I can form is that the discrepancies are due to carelessness or ignorance on the part of the observers. The observatories in question are those situated at Gya and Durbhunga. The only other explanation is that these stations possess very peculiar meteorological conditions, and that the discordance, the observations at these stations present, when compared with those of neighbouring stations, is due to a want of uniformity in nature, and not to defects in the observer or in his instruments. This solution of the discrepancy has been suggested in correspondence on the subject, but I am unable to accept it as the true solution, or to recommend it to Government as an explanation of the peculiarities in the observations at these stations.

Durbhunga Observatory—Was visited on the 25th of November 1883. The observer was absent from the station and had left his duties to be performed by a friend, without giving any intimation to the Meteorological Office. As specific orders had been given to the observer on a similar occasion (in November 1882) not to absent himself from his duties without giving the usual intimation to this office and obtaining the necessary sanction, the observer was called upon for an explanation. This was not satisfactory. The state of the observatory last year was disgraceful, and it was mainly in consequence of the observer's promise to be very careful in future, and to carry out the various regulations and orders with respect to the taking of observations diligently and exactly, that he was not deprived of his special allowance of Rs. 5 per mensem. As he has failed to comply with the clear and precise orders necessary to secure the continuity of accurate observation, I had no alternative but to recommend the Meteorological Reporter to the Government of India to withdraw his special allowance for a period of six months when he will be again permitted to draw it, if in the *interim* his observations are found to be satisfactory in character by comparison with those at neighbouring stations.

¹⁸ 1st April to 3rd July and 9th October 1883 to 31st March 1884.
9th July to 8th October 1883.

²⁰ 1st April to 31st August, and 1st December 1883 to 31st March 1884.

²¹ 1st September to 30th November 1883.

The shed was in good order and the thermometers fairly clean. The barometer was also satisfactory. The clock which was sent a few months previously was out of order, apparently due to carelessness on the part of some one, as there were signs of its having been dropped, or of its having fallen down. The wind-vane was excessively stiff, and had evidently not been oiled for months. I turned it round through an angle of 120° , and a small puff of wind which caused the anemometer to make 30 revolutions in a minute had no effect in moving it. The wind directions at Durbhunga for months past are hence, I fear, of little value. The anemometer was clean and in fair order. The observatory has improved since last year, but is by no means satisfactory; and I am unable from my continued experience of the observer's carelessness and neglect of orders to place confidence in his observations. If considerable improvement does not occur during the next year, I shall be compelled to call the attention of the Government of Bengal to the unsatisfactory character of the Durbhunga observatory.

Dacca Observatory.—My head clerk, who visited Dacca on his way to the new third class observatories in Eastern Bengal, reports as follows on the observatory at that station:—

The Dacca observatory was inspected on 13th February 1884. The barometer was in the same position as on the last inspection. The room has, however, been converted into a sitting room for the use of the Superintendent of Telegraphs of the Dacca Division, and he suggested that the barometer should be placed in another room. It was therefore decided to remove it to one of the office rooms where a suitable exposure will be provided for it. (This has since been done.)

The thermometers were in good order, but very dirty. The bulbs of the wet bulb thermometers were thickly covered with encrustation. The observer was instructed how to keep them clean for the future. The receiving bottle in the rain-gauge was found to be full of dust. There was a depth of at least a quarter of an inch of earthy matter collected at the bottom.

The anemometer and wind-vane worked well. They were clean and properly oiled.

The observer takes his readings accurately. The want of cleanliness in the thermometer shed is a fault which should be remedied. An observer who is interested in his work will always be careful to keep every instrument he uses as clean as possible compatible with the conditions of observation; and want of cleanliness is an almost unfailing evidence of carelessness and inaccuracy of observations.

Provincial Third Class Observatories.—These are the additional observatories established in accordance with the extended system sanctioned last year, and maintained from the Provincial Meteorological grant. They are 22 in number. The names of the superintendents and observers at these stations are given in the following table:—

Provincial Third Class Observatories.

STATIONS.	Name of Superintendents.	Name of Observer.	Observer's allowance.
Balasore . . .	J. H. Apjohn, Esq., Executive Engineer .	Baboo Radha Mohan Dass, Head Clerk	Rs. 10
Midnapore . . .	Major A. D. McArthur . . .	Mr. Benjamin Augier . . .	10
Ranigunge . . .	.....	Baboo Sreeram Chunder Ghose, Civil Hospital Assistant.	10
Noakholly . . .	<i>Nil</i> . . .	Baboo Benod Behary Paul, Supervisor, Public Works Department.	10
Burrisaul . . .	<i>Nil</i> . . .	Baboo Hemcanto Deb, Overseer, Public Works Department, aided by Sub-Overseer.	10
Serajunge . . .	<i>Nil</i> . . .	Baboo Heralal Seal, Telegraph Master	10
Commillah . . .	<i>Nil</i> . . .	„ Nobin Chunder Biswas, Supervisor, Public Works Department, aided by Sub-Overseers.	10

Provincial Third Class Observatories—continued.

STATIONS.	Name of Superintendents.	Name of Overseer.	Overseer's allowance.
Furreedpore . . .	<i>Nil</i>	Baboo Kadar Nauth Roy, Overseer, Public Works Department.	Rs. 10
Mymensingh . . .	Baboo Rakhal Das Chatterjee, Assistant Engineer.	Baboo Bamacharan Bose, Sub-Overseer	10
Rampore Beaulah . .	Executive Engineer	„ Gopal Chunder Chatterjee, Head Clerk.	10
Dinagapore . . .	Executive Engineer, Julpigoree Division .	„ Behary Lal Banerjee, Overseer .	10
Rungpore . . .	Ditto ditto ditto	„ Dijobar Goopto	10
Julpigoree . . .	Baboo Madhub Chunder Roy, Executive Engineer, Julpigoree Division.	„ Woomanath Moitro, Head Clerk	10
Bhagulpore . . .	{ T. Beaty, Esq., Executive Engineer ¹ . . . D. F. Martin, Esq., Executive Engineer ² }	„ Jogut Chunder Bhadhary, Head Clerk.	10
Chupra . . .	<i>Nil</i>	„ Kaliprosanna Moitra, Sub-Overseer.	10
Motihari . . .	{ Baboo Durga Charan Chackravati, Assistant Engineer ³ Mr. J. Butler, Assistant Engineer ⁴ . . . Mr. C. J. Clarke ⁵ }	Baboo Rajendra Nauth Biswas, Sub-Overseer.	10
Buxar . . .	Executive Engineer	Baboo Boycontonath Guho . . .	10
Arrah . . .	Executive Engineer	Mr. T. Webb	10
Dehree . . .	Executive Engineer, Dehree Workshops .	{ Baboo Tulsi Das Roy, Supervisor ⁶ . „ Peary Lal Sen, Assistant Surgeon ⁷ . „ Poorno Chunder Purkait ⁸ . }	10
Nya Doomka . . .	Dr. R. A. Barker, Civil Surgeon, Sonthal Pergunnahs.	„ Dwarkanath Mookerjee . . .	10
Ranchee . . .	<i>Nil</i>	„ Peary Mohun Banerjee, Overseer	10
Chyebassa . . .	The Head Master, Zillah School . . .	„ Motilal Sarkar, 3rd teacher, Zilla School.	10

As the orders of the Government of India sanctioning the proposals of the Government of Bengal for the extension of meteorological work in Bengal were not received until the middle of March (Revenue and Agricultural Department No. 17 Meteo., dated 13th March 1883), it was not possible to arrange that the sheds should be built and the work of observation commenced by the date originally proposed, *viz.*, 1st April 1883.

My college duties prevented my visiting the various stations to select the sites for the observatories; it was therefore necessary to leave this to the judgment of the Public Works officers. Instructions were communicated to them, and in the great majority of cases excellent sites were chosen. In some few instances difficulties of various kinds prevented the utilization of the most suitable site

¹ From 4th June to 22nd July 1883.

² „ 23rd July to 31st March 1884.

³ „ 30th May to 3rd December 1883.

⁴ „ 1st January to 8th February 1884.

⁵ „ 9th February to 31st March 1884.

⁶ From 1st April to 14th May 1883.

⁷ „ 15th May to 28th November and 10th February to 31st March 1884.

⁸ „ 29th November to 9th February 1884 (Baboo P. L. Sen on leave).

selected by the Public Works officers. In these cases sites more or less inconveniently situated and badly exposed were necessarily chosen. The observatories erected on these sites will, as the value of the extended meteorological system is recognised, I feel confident, be permitted to be removed to more suitable positions than they at present occupy.

I deemed it advisable to spend a considerable part of the college vacation in visiting these observatories to ascertain the condition of exposure of the instruments and to remedy any defects that might have arisen in the construction of the sheds, arrangement of the instruments and the methods of observation. The sites, it should be remembered, were selected by Public Works officers in accordance with instructions issued from this office, and the work of observation carried on by Overseers or Sub-Overseers of the Public Works Department who had received no previous training, and merely carrying out as they best could (frequently with the assistance of the Assistant Engineers or Executive Engineers) the methods and instructions as described in the *Vade Mecum*. The results, as will be seen from the following reports on the stations visited, were very much more satisfactory than I expected. A few defects were observed, but in the great majority of cases the work of observation was performed quite as satisfactorily and accurately as at the third class stations. The reports are given in the order of place and not in the order of time of inspection.

Ranigunge Observatory—Was inspected twice during the year. The observatory is attached to the subsidiary jail, the hospital assistant who is in charge of the jail taking the observations. The shed is erected in a large open space enclosed by the jail walls, and is constructed in accordance with the standard plan. The walls enclosing this compound are from 6 to 10 feet high, and are at distances varying from 20 to 60 yards from the shed. The instruments were in good order. The rain-gauge is placed in the open near the observatory shed, at a distance of about 10 yards.

The barometer is kept in the office room, and is in good light.

The wind-vane and anemometer are placed on the roof of the office room, and are well exposed, as they are on the highest part of the jail buildings, which are on the highest ground in the station, and at a considerable distance from large trees.

The observer had some difficulty in learning to read the barometer and anemometer correctly. He was not able to procure any assistance in Ranigunge, nor was he able to leave his post to come to Calcutta for a course of instruction at the Alipore observatory. Hence my two visits were chiefly spent in teaching him to read these instruments correctly.

The observer appears to be careful in his work and willing to do his best. The observations have been during the latter part of the year fairly satisfactory and trustworthy.

Noakholly Observatory.—The Noakholly observatory was inspected by my head clerk on the 6th February 1884. The shed is in the circuit-house compound, and is generally built in accordance with the standard plan. The eaves were found to be $2\frac{1}{2}$ feet higher than they ought to have been. The instruments were in good order. The anemometer worked very heavily. On examination it was found to be defective. The teeth of the cog-wheels were worn away. The instrument was returned to Calcutta and replaced by another.

The observations at Noakholly have hitherto been taken by the Overseer, who is frequently obliged to leave the station on duty; there have hence been frequent breaks in the observations. The Magistrate suggests certain changes, which will, if carried out, secure continuous observations. He proposes that the shed be removed to the jail compound (in which there is a very large open space where it would be conveniently placed) and that the anemometer and wind-vane be placed on the roof of the collectorate and the barometer in one of the rooms of the Collector's cutcherry (*viz.*, the Collector's waiting-room). If this were done, the civil hospital assistant, who is in charge of the jail dispensary, would be able to take the observations, and as he is very intelligent and lives in quarters in the jail, his appointment as observer would secure regular and continuous, and in the opinion of the Magistrate, accurate and trustworthy observation. The changes suggested by the Magistrate will therefore, if possible, be carried out.

Burrisaul Observatory—Was inspected by my head clerk on the 31st January and 1st February 1884. The observatory is situated at a distance of about one and a half miles from the circuit-

house bungalow and close to the Burrisaul river. To the south of the observatory shed, at a distance of about 250 feet, is the depôt for the night-soil of the district jail prisoners (numbering 500). The site is objectionable on this and other accounts. The ground is low. The site is near the river, and during the rains, when it is full, the water overflows and reaches within 50 or 60 feet from the shed. There is also a large tope of mango and other trees at a short distance to the south-west. The site is open in other directions. The barometer is, however, kept in the Public Works Department inspection bungalow, at a distance of one and a half miles from the shed, and a single set of observations hence requires two observers, one to read the barometer and the second the remaining instruments. The shed was originally erected in the circuit-house compound, but was removed by the orders of the Commissioner according to information received by the Inspector.

The Magistrate suggested its retransfer to its previous site, where it would be near to the room in which the barometer is kept, and also to the Public Works offices in which the observer is employed.

The instruments were found clean and in good order. The wind-vane and anemometer are placed on posts about 10 feet high. The barometer is kept in the Public Works Department inspection bungalow, and was found to be in good condition. The Public Works Department Overseer, who has taken the observations since the establishment of the observatory, takes much interest in his work and reads the instruments carefully and correctly.

Serajunge Observatory—Was inspected by my head clerk on the 20th, 21st, and 22nd February 1884. It is situated in the grounds of the Telegraph Office close to the circuit-house bungalow. The district is low and flat. The soil is sandy and very porous, and dries rapidly after rain. In the rainy season the whole district is flooded.

The observing shed is well built, and is of the standard pattern, but of dimensions slightly different from those in the *Vade Mecum*. The whole structure stands on masonry work two feet eight inches from the ground. This was necessary as the ground is covered with water during the rains to a depth occasionally exceeding one foot and a half. The eaves of the shed being so high from the ground, the sun and rain strike inside the shed. The cage was found to be shaky. This has since been made right. The barometer is kept in the signal room of the Telegraph Office, which is a thatched shed. There is no pucca Government building near the Telegraph Office where the barometer can be placed. The instrument is in good order.

The cage instruments are in good order, excepting the wet thermometer, the bulb of which was partially covered with encrustation. This was owing to the use of well water for the reservoir. The observer was cautioned against the use of any water except rain and distilled water, and in their absence well boiled water.

The raingauge requires to be embedded in masonry work at least one foot high to protect it from being flooded over during the rains. The observer did not know that he had to use the receiving bottle for the gauge. It was kept aside in a godown. His attention was drawn to the chapter in the *Vade Mecum* on "Raingauge."

The wind-vane and anemometer are placed on the roof of the sub-collectorate, a one-storied building about 15 feet high. The instruments are reached by a strong ladder, and are at present fixed on two small blocks of wood on the parapet of the roof; but they are likely to be blown down. The observer has therefore been asked to submit an estimate of the cost of erecting masonry pillars on which to place the instruments as directed in the *Vade Mecum*. It is proposed to erect a block of two-storied buildings for the collectorate, and when they are completed the wind-vane and anemometer might be removed to the top of the new building, which will give a good exposure for the instruments.

The level of the barometer has not yet been determined for want of a datum level, the nearest bench-mark being several miles off from the station.

The observer takes much interest in his work, and records his observations very accurately.

Commillah Observatory—Was inspected by my head clerk on the 9th February 1884. The station is situated on level ground. Throughout the district are scattered numerous large tanks.

To the north-east rise the Tipperah Hills, which are visible from Commillah in clear weather, and form a prominent feature in the landscape. The river Goomtee passes to the east of the station of Commillah at a distance of about half a mile, and to the west the Megna, a deep and very broad stream.

The barometer is kept in a room of the road cess buildings and is in good order. The thermometer shed is erected on the western edge of a large tank, at a distance of about 10 feet from the edge of the water. It is well built and in good order. Except on the side towards the tank, it is surrounded by a fence at a distance of about 30 feet from the shed. The maximum thermometer was found to be out of order, and another was called for by telegram. The wind-vane and anemometer were originally placed on the roof of the collectorate, at a distance of about 150 feet from the room containing the barometer and 300 feet from the thermometer shed. The anemometer was returned to Calcutta as defective in August 1883. The roof of the collectorate is, however, not a very suitable place for the wind-vane, as it is a low one-storied building surrounded by tall trees, many double the height of the building. Hence the wind observations are not taken under satisfactory conditions, and it may be desirable to erect the wind-vane and anemometer on posts or pillars in the open ground near the thermometer shed.

The observations are taken by the supervisor and two sub-overseers of the Public Works Department, and have been accurate and satisfactory in character from the commencement. The shed is neatly constructed and the instruments very clean and in capital order. The condition of the observatory generally reflects very great credit on the supervisor.

Mymensingh Observatory—Was inspected by my head clerk on the 25th, 26th, and 27th of February 1884. The town is situated on the west bank of the Brahmaputra river, which runs as a shallow broad stream (during winter) with high banks. The whole of the district is level and open, with the exception of the Muddapore jungle, which lies to the south-west, comprising an area of about 45 miles in length by 6 to 16 miles in breadth. This part is slightly elevated, averaging in height some 50 to 60 feet above the general level. The district is also intersected by many small rivers.

The observatory is situated in an open field close to the zillah and vernacular schools, the collectorate, and the Public Works Department offices. The shed is of the standard pattern and well built. The ventilating hole required to be replaced by a section of a bamboo as directed in the *Vade Mecum*. The site is open, but being near the play-grounds of the two schools, the instruments are subject to interference from the boys. There is a bamboo fencing round the shed, but it does not appear to be strong enough to keep off mischievous boys. It is desirable therefore to have a strong wooden fence round the shed with a small gate for entrance, which should remain closed against outsiders.

The barometer is kept in an office room of the Public Works Department, and well placed. The instrument is in good order. The height of the mercury in the cistern of the barometer above sea level has not been determined for want of a datum level. The observatory was without the hygrometers. They were reported to have been broken by some of the boys of the neighbouring schools. The maximum and minimum thermometers were properly exposed and were in good order. From a local investigation of the circumstances attending the breakage of the thermometers, the head clerk ascertained that the mischief was due to one Rajendro Kissore Roy of the 4th class of the Hardinge School, who was willing to pay for new instruments. The head master was asked to recover from the boy Rs. 20—the cost of the thermometers—and pay it into the treasury.

The wind-vane and anemometer are placed on two pillars on the top of the turret clock-tower in the collectorate, 52 feet high. The position is quite open and equal to that of the Alipore observatory. The rod of the wind-vane (Adie) was found to be slightly bent; this was (as reported) owing to the injury it had received during transit to Mymensingh. The instruments worked well and were found to be well oiled. The rain-gauge is well placed. The fence was a little too near. It has been removed further off.

The observer reads his instruments correctly. The Assistant Engineer takes great interest in the proper working of the observatory, and has trained the observer (a sub-overseer) well. The Public Works Department is providing a ladder to reach the top of the clock-tower.

Furreedpore Observatory—Was inspected by my head clerk on the 16th of February 1884. The shed is situated in the centre of a fairly large open maidan near the police lines, and at a short distance from the circuit-house.

It is well and strongly built, but, through some oversight, not exactly in accordance with the Bengal pattern. The chief defects were that there was no ventilating hole in the roof to permit the escape of heated air, and that the eaves were somewhat too high. These defects have since been remedied.

The thermometers were generally in very fair condition. The wet bulb was covered with a thickish encrustation in consequence of the use of tank water instead of rain water. The barometer is kept in a room in the jail building, and was found to be in good order. The raingauge is placed near the observer's home at a distance about half a mile from the shed, and was in good order. The wind-vane and anemometer were erected on a platform supported by posts with a bamboo ladder to reach them. The latter instrument was somewhat dirty. It was hence taken down and cleaned, and the observer instructed in the method of cleaning and oiling it.

The observer read the instruments correctly and takes much interest in his observations, which have been on the whole very satisfactory during the year.

The only defect in the observatory is that the instruments (barometer and raingauge) are situated at considerable distances from one another and the shed, and also from the house and office of the observer. My head clerk suggested the removal of the shed to a position in a field belonging to the municipality. I have, however, not thought it advisable to make any change at present, as the observations under the present system seem to be quite trustworthy and taken at the proper hour daily, and the removal of the observatory from one part of a station to another, to suit the convenience of the observer, would speedily do away with uniformity in the conditions of observation and registration.

Rampore Beaulah Observatory—Was inspected by my head clerk on the 10th and 11th January 1884. The observatory is situated near the Executive Engineer's office at about a mile and a half from the city. The river Ganges (Padma) flows as a deep wide stream to the south of the observatory at a distance of about 500 feet from the shed.

The barometer is kept in a room in the Executive Engineer's office. It was in a bad position as the light came directly from the front. The instrument has since been removed to a better and more secure position in the same room. The sea level height has not been affected thereby.

The thermometer shed is of the standard pattern, but the air hole on the top of the shed instead of being a ventilating pipe was found to be of the form of an elliptical hole (about 2 feet by 1½ feet) permitting the sun's rays to enter at certain hours of the day, and affecting the thermometric readings. This has been remedied.

The thermometer cage instead of being set upon the southern pole in the shed had been fixed by means of two additional posts in the middle of the north and the south poles supporting the ridge. The observer was asked to set it in the proper place.

The thermometers were in good order with the exception of the wet bulb hygrometer. The bulb of this instrument was found to be completely coated with a thick deposit, and the muslin had evidently not been changed for some time, as it was very dirty. The muslin was removed. Instructions for keeping the instrument in order were also given to the observer.

The anemometer and wind-vane are placed on the terrace roof of the Executive Engineer's office, and appear to be in a satisfactory position. There are several high trees to the north and north-east of the building at a distance of about 100 or 150 feet from it, but they probably do not influence the wind direction to any appreciable extent. The anemometer was full of dirt and appeared to work with much friction. It was taken down, cleaned and oiled and reset in position, and the observer instructed to keep it clean in future.

The raingauge is in the garden compound of the Executive Engineer. The mouth of the funnel was not level. The funnel hole was completely choked up by dirt and earth. The rain receptacle was also far from being clean.

The observer read the instruments well.

Dināgepore Observatory—Inspected by my head clerk on the 8th January 1884. It is situated near the circuit-house in a fairly open space, but on low ground. The river Poonarvava flows to the west and north-west of the observatory at a distance of about one-fourth of a mile.

The barometer is placed in a brick-built store-room of the Public Works Department, and is in good light. The instrument was clean and in good working order. The shed is entirely of bamboo work, but strong and well thatched, and laid out according to the standard plan.

The thermometers are all properly exposed and in very good order. The anemometer and wind-vane are placed on the terrace of the Judge's court-house at a distance of about 725 feet from the thermometer shed. To the north and north-west of the building, at a distance of 100 to 140 feet, there are several large trees which overtop the instruments on the terrace. The instruments were in good order.

The raingauge is well placed, but the fencing was too near the instrument. The observer was instructed to remove it to a further distance, and this has since been done.

The observer is a subordinate of the Public Works Department. He appears to take great interest in his work, and reads the instruments correctly.

Rungpore Observatory.—The station of Rungpore is in the plains of Northern Bengal on low flat land between the rivers Teesta and Cusi. The observatory is erected on a large open maidan near the Collector's cutchery. The ground is somewhat low and apt to be flooded during heavy rains. The barometer is kept in an out-room of the Collector's court, and is conveniently situated in a good light.

The thermometer shed is situated about 100 feet to the north-west of the northern extremity of the Collector's cutchery. The post office is situated in about the same distance to the west; with the exception of these two buildings, the ground in the neighbourhood is very open and quite free from trees. The shed is very well built and was clean, and the instruments in satisfactory working order.

The anemometer and wind-vane are erected on the school-house—a building about one-fourth of a mile to the south of the observatory. The building is a lofty one, and the instruments are placed on small brick pillars, and are thoroughly well exposed. They are approached by substantial ladders.

The observatory is well built and the observations trustworthy. It reflects much credit on the Assistant Engineer who selected the site and superintended the erection of the observatory and the commencement of the work of observation.

Fulpigoree Observatory—Inspected on the 6th January 1884. The observatory is situated on a large open maidan near the Executive Engineer's office and within a few minutes' walk from the railway station. The site is open, as the nearest trees and buildings are at a considerable distance. The river Teesta flows past the station at a distance of about half a mile to the east and north-east of the observatory. The banks of the river are low, and the district is alluvial.

In the absence of any brick building near the observatory, the barometer is kept in a thatched godown belonging to the Public Works Department walled by thick *durma* mats all round. It is in fair light and in good working order.

The shed is constructed of bamboo on the pattern laid down in the *Vade Mecum*. It is neatly and strongly built. The thermometers are in good order. The raingauge is well placed and free from any obstruction in all directions.

The anemometer and wind-vane are placed on a wooden platform 18 feet high, supported by poles with ladders to reach them. The vane is correctly set. The anemometer worked somewhat heavily and had evidently not been cleaned or oiled since its erection. It was taken down, cleaned, oiled, and reset in position, and the observer instructed how to keep it clean and in good working order. The head clerk of the Executive Engineer's office is the observer. He reads the thermometers correctly, but was doubtful and slow about the barometric and anemometric readings. Fortunately the Executive Engineer is much interested in the observatory, and frequently takes the barometric readings, so that the barometric observations hitherto taken have generally been satisfactory.

The observer was drilled for some time in reading the two instruments with fairly satisfactory results.

Bhaugulpore Observatory—Inspected on the 17th and 18th November 1883. The observatory is situated in the compound containing the dispensary and the Assistant Surgeon's quarters. It is on fairly open ground and well situated. The barometer is kept in a room of the dispensary, and is placed in a satisfactory light. The anemometer and wind-vane are both erected on the roof of the dispensary, and are reached by strong ladders. There are numerous trees in the neighbourhood, but they are at some distance away, and do not influence the readings of the wind-gauging instruments. The observatory is fairly good as to situation: the instruments well placed and in good order. The observer is also head clerk to the Executive Engineer, and is apparently both accurate and careful in his work.

Chupra Observatory—Was inspected on the 5th and 6th of December 1883. The station is situated on the northern bank of the Ganges, and is in the midst of a flat, well cultivated alluvial district. The observatory shed (well fenced in) is erected in the compound of the circuit-house bungalow, in one of the rooms of which the barometer is kept. The shed is neatly and strongly built in accordance with the Bengal pattern, and was found in very good order. The thermometers were all in good order, except the wet bulb, which, on examination, was found to be wrongly graduated. This defective instrument had apparently been issued without due examination by some oversight in both the Bengal and India offices. The readings of the wet bulb for the preceding months are hence entirely wrong, and the deduced humidity values of this station published in the Bengal daily weather reports during last year incorrect and misleading. A new wet bulb was sent very shortly afterwards to replace this defective instrument.

The wind-vane and anemometer are erected on the roof of the road cess offices. They are about 30 feet from the ground, and the neighbourhood is fairly open and free from large trees, so that the exposure is satisfactory.

The raingauge is kept in the compound of the same buildings. The distance between the circuit-house bungalow and the road cess offices is between one-fourth and half of a mile. This separation of the wind-recording instruments is not very satisfactory, but I was unable to propose any other arrangement, as it is very difficult to obtain a good exposure for wind-vane and anemometer in a mofussil station.

The instruments were all in good order, and the observer was accurate in his readings.

Motihari Observatory—Inspected on the 21st and 22nd November 1883. The station is in the Chumparun district, and is situated in a level alluvial district about 20 miles to the east of the river Gundack. The observatory is placed on a large maidan or open space between the new collectorate offices and the railway. There are no trees in the neighbourhood, as the new collectorate buildings have been erected at some little distance from the old station, and hence its exposure is much more open than in the case of the majority of our stations, and represents more closely the atmospheric conditions of the surrounding district than is usually the case. The shed is very substantially and neatly erected. It is enclosed at some distance by an open latticework which allows complete circulation of the air, but prevents admission to the cattle which pasture on the maidan. The thermometers were all clean and in good working order except the maximum in shade, which had apparently reached the observatory in a defective condition. (It was replaced by a correct instrument.) The barometer is kept in the Collector's waiting-room. The light is good, and the instrument in efficient working order. The anemometer is placed on one of the highest points of the collectorate buildings in capital position. The wind-vane has been for the present placed on the top of the central pole of the shed, and is reached by means of a ladder reclining on the roof of the shed. This is the only instrument that is not satisfactorily placed, and it would be very desirable to have the wind-vane placed on the top of the collectorate building in the position which I pointed out to the sub-overseer and observer. Strong ladders should be provided to enable the observer to mount to the roof of the collectorate with comfort and rapidity.

The observatory is in a very satisfactory state, and reflects much credit on the observer.

Buxar Observatory—Inspected on the 7th December 1883. The observatory at this station is in the fort. The interior of the fort is considerably elevated above the surrounding ground. At a

short distance to the north of the fort the Ganges flows past. The river here has the same character as at Benares. It flows as a deep stream between highish banks. The southern bank appears to be the higher at Buxar. There is no wide stretch of sand through which the river flows, as is the case in the lower reaches of the river. The only building in the fort is the office and residence of the Executive Engineer of the Buxar Canal. The barometer is kept in a room of the office and is in a very good light. The shed is erected in a small depression in the mud wall enclosing the fort, and is well exposed. The instruments were very clean and in good order. The wind-vane and anemometer are erected in one of the corner bastions, and are thoroughly well exposed and in perfect order. The observer reads the instruments carefully and correctly. The observatory is in very satisfactory order, and the observations of high value for accuracy.

Arrah Observatory.—Was inspected on the 4th and 5th December 1883. The observatory is in the compound of the office of the Superintending Engineer of the Sone Canals at a short distance from the railway station. The site is fairly open. The shed is strongly built, and is in very good order. The barometer is placed in a large office room and is in a capital light. The thermometers were all in good order, except the minimum in shade, the column of which had given some little trouble from its tendency to break. The observer was taught how to remedy this defect. The raingauge is in open ground near to the observatory. The wind-vane and anemometer are on the roof of the building, and are well exposed. The observatory is very satisfactory, and the observer accurate and careful in his work.

Dehree Observatory.—Was inspected by my head clerk on the 22nd March 1883. It is situated in the Dehree Workshop dispensary compound. The shed is very old and shaky, and the thatching is thin and worn-out. The instruments in the cage were not set according to the approved standard regulations. They were correctly placed. There should be a fence round the shed. The barometer is placed in a room in the dispensary building, and was found in good order.

The thermometers were clean and in good order. The minimum thermometer was found to have some cotton stuffing inside the hole on the wooden board near the bulb. This has since been removed. The presence of the cotton stuffing quite close to the bulb may have slightly affected the minimum thermometer readings of the past months.

The anemometer and wind-vane are set up on the top of the dispensary bungalow. They are reached by a strong ladder and a flight of steps on the sloped roofing. The instrument is fixed to the upper end of a gas pipe five feet high, and is hence shaken by the slightest wind. The wind-vane (Adie) is placed close to and on a level with the cups of the anemometer, and is kept in continual motion by the rotation of the anemometer. As an effect of the shaking the pivot screw nut on the back of the dial wheels of the instrument had been thrown off from the worm of the screw and lost. The observer was asked to have the nut replaced from the workshops. Other instruments were found to be quite satisfactory.

Baboo Peary Lall Sen, Assistant Surgeon, is the observer. He reads the instruments fairly, and takes much interest in his meteorological duties.

Nya Doomka.—Is situated in the Sonthal Pergunnahs at an elevation of about 500 feet in the midst of the broken country between the plains of Southern Behar and the Gangetic Delta. The station itself is situated on fairly level and open ground, but in its neighbourhood there are many low hills more or less wooded.

The observatory shed is in the compound of the dispensary. The shed was erected according to the pattern plan under the supervision of the Civil Surgeon, and is well built and in good order. The instruments were properly exposed and in satisfactory condition. The barometer is well placed in the office room of the Civil Surgeon.

The raingauge is placed at a short distance from the shed. The wind-vane was erected on the top of a pole about 16 feet high, and was read from below. The anemometer was not in position, as there is no proper building near the dispensary with a flat roof on which to erect the wind-vane and anemometer. I have since my visit sanctioned the erection of a brick pillar with a brick staircase for the accommodation of these instruments.

The observatory is in very satisfactory order, and the observer careful and accurate in his record of observations. The observatory is the only one as yet in operation in the large district known as the Sonthal Pergunnahs, and will, I trust, give observations of very considerable value. Its establishment was due to a suggestion from the Civil Surgeon, who has taken much interest in it, and made it one of the most efficient of those started last year under the new system.

Rainfall-recording stations.—There has been a slight increase in the number of rain-recording stations during the past year. In 1882-83 the number was 162, and in the official year 1883-84 it was 167. This increase is due to the establishment of the following rainfall stations:—

	Date of first sending in returns.	
Naraingunge	June	1883.
Nowgong	July	"
Siligoree	Do.	"
Dehree	Do.	"
Lohardugga	January	1884.

The returns from the great majority of these stations were received punctually and regularly. Delays occurred in the submission of the returns occasionally. The only stations which gave frequent trouble in this respect were Bagirhat (in Khoolna district) and Jagatsingapore (in the district of Cuttack). It was necessary on several occasions to call the attention of the sub-divisional officer in charge of the former station to the delay and inaccuracy in his rainfall reports.

Some of the rain-registering gauges for revenue purposes (*viz.*, at Commillah, Mymensingh, Rampore Beaulah, Burrisaul, Serajgunge) were examined by my head clerk on his visit from district to district during his inspection of the local observatories. He found in the case of every rain-gauge that he examined a large accumulation of dirt in the gauge and glass receiver; hence it appears to me probable that the rain-gauge and appendages are generally not kept as clean as they ought to be. Experience shows me that carelessness in not keeping instruments clean is frequently accompanied with carelessness of observation. I am of course not able to assert that such is the case in the rainfall-registration of Bengal. So far as I can judge from the examination of the rainfall returns, the registration of rainfall is effected with approximate accuracy, and the returns give generally consistent and continuous variations from district to district, which are the strongest proof of their correctness. In a few cases during the year they were evidently inconsistent, and probably wrong, due either to careless reading or neglect to measure the rainfall at the proper hour.

Instruments.—The following tables show the number of instruments that have been broken, or lost, or rendered unserviceable during the year 1883, at the Imperial and Provincial observatories, and of the instruments supplied to them during the year. The additional Provincial observatories, 22 in number, were finished with complete sets of instruments shortly after the commencement of the official year. These instruments were received almost without exception in good order, due mainly to the careful way in which they were packed by the Mathematical Instrument Department:—

Return of Instruments broken or otherwise injured at the Imperial Observatories in Bengal and Assam, 1883-84.

STATIONS.	Barometer.	HYGRO-METER.		Dry maximum.	MINIMUM THERMO-METER.		RADIATION THERMO-METER.		Anemometer.	Wind-vane.	Rain-gauge.	Measure glass.	Lens.	Clock.	Sand glass.
		Dry.	Wet.		Dry.	Wet.	Solar.	Grass.							
Patna
Cuttack
Chittagong	1	...	...	...	...	...	...	...	...	...
Saugor Island
Hazaribagh	(a) 1	...	...	...	...	...	...
Purneah	1	...	...	...	...	...	...	...

(a) Worn out by prolonged use.

Return of Instruments broken or otherwise injured at the Imperial Observatories in Bengal and Assam, 1883-84—(continued.)

STATIONS.	Barometer.	HYGRO-METER.		Dry maximum.	MINIMUM THERMO-METER.		RADIATION THERMO-METER.		Anemometer.	Wind-vane.	Raingauge.	Measure glass.	Lens.	Clock.	Sand glass.
		Dry.	Wet.		Dry.	Wet.	Solar.	Grass.							
Burdwan
Berhampore
St. Paul's School, Darjeeling
Jessore	I	...	...	...
False Point
Dacca
Durbhunga	I	...	...	...	...	...	I	...
Gya	(a) I	...	...	(a) I	...	...	(a) I	...	...	...	...	...	...
Akyab
Gopalpore	(a) I	...	...	...	...	...	...
Coconada
Sibsagar	I	...	...	...	I	...	...	(a) I	...	...	...	...
Dhubri	(b) I	...	...	...	...	...	...	...
Cachar
Tura
Demagiri

(a) Worn out by prolonged use.

(b) Stolen.

Return of Instruments, &c., broken or otherwise injured at the Provincial stations in Bengal, 1883-84.

STATIONS.	Barometer.	HYGRO-METER.		Dry maximum.	MINIMUM THERMO-METER.		RADIATION THERMO-METER.		Anemometer.	Wind-vane.	Raingauge.	Measure glass.	Lens.	Clock.	Sand glass.
		Dry.	Wet.		Dry.	Wet.	Solar.	Grass.							
Balasore	(c) I	...	...	...	...	...	...
Midnapore
Ranigunge
Noakholly	(c) I	...	...	...	...	...	...
Burrisaul
Serajgunge
Commillah	(e) I	...	...	...	...	(e) I	...	...	...	...	...	...
Furreedpore
Mymensingh	(d) I	(d) I	...	...	...	...	...	...	...	...	...	...	...	...
Rampore Beaulah
Dinapore
Rungpore	(e) I	...	...	...	...	...	...	...	...	...	...
Julpigoree
Bhaugulpore

(c)—Defective.

(d)—Broken by a student of the Hardinge School, who paid for new instruments.

(e)—Out of order in transit.

Return of Instruments, &c., broken or otherwise injured at the Provincial stations in Bengal, 1883-84—(continued.)

STATIONS.	Barometer.	HYGRO-METER.		Dry maximum.	MINIMUM THERMO-METER.		RADIATION THERMO-METER.		Anemometer.	Wind-vane.	Rain-gauge.	Measure glass.	Lens.	Clock.	Sand glass.
		Dry.	Wet.		Dry.	Wet.	Solar.	Grass.							
Chupra
Motihari	(e) 1	...	...	(f) 1	...	...	...	...	...	...	...	...	...	...	...
Buxar
Arrah
Dehree
Nya Doomka
Ranchee
Chyebassa

(f)—One condemned as defective.

(e)—Out of order in transit.

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Return of Instruments, &c., issued to start the Provincial observatories in Bengal during 1883-84.

STATIONS.	Barometer.	HYGRO-METER.		Dry Maximum.	MINIMUM THERMO-METER.		RADIATION THERMO-METER.		Anemometer.	Wind-vane.	Rain-gauge.	Measure glass.	Lens.	Clock.	Sand glass.
		Dry.	Wet.		Dry.	Wet.	Solar.	Grass.							
Balasore	1	1	1	1	1	...	...	...	(a) 2	1	1	1	...	...	...
Midnapore	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Ranigunge	1	1	1	1	1	...	...	...	1	1	1	1	...	1	...
Noakholly	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Burrisaul	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Serajgunge	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Commillah	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Furreedpore	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Mymensingh	1	3	2	1	1	...	...	...	1	1	1	1	...	...	...
Rampore Beaulah	1	1	1	1	1	...	...	...	1	1	1	1	1	...	...
Dinagepore	1	1	1	1	1	...	...	...	1	1	1	1	1	1	...
Rungpore	1	1	1	1	(c) 2	...	...	...	1	1	1	1	...	...	...
Julpigoree	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Bhaugulpore	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Chupra	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Motihari	2	1	1	2	1	...	...	...	1	1	1	1	...	...	...
Buxar	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Arrah	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Dehree	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Nya Doomka	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Ranchee	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Chyebassa	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...

(a). To replace a defective instrument.

(c) One out of order in transit.

The number of instruments destroyed by accident during the year was unusually small. The Chittagong, Purneah, Durbhunga, and Sibsagar observers each broke a thermometer during the course of the year whilst handling them at the time of taking the observations. No breakages have occurred during the year at the new stations. This is partly due to the fact that they are not provided with radiation thermometers which are the most liable to damage on account of the conditions of their exposure. It, however, indicates that the new observers have been very careful of their instruments, and it is exceedingly creditable to them.

A grass radiation thermometer was stolen at Dhubri. Efforts were made to discover the thief, but without success. Two thermometers, the wet and dry bulb thermometers, were broken at Mymensingh in the month of January. Suspicion fell on one of the boys of the vernacular school, and when my head clerk was in the station inspecting the observatory, he enquired carefully into the matter. The result was that the cost of the instrument was recovered from the guardians of the boy who broke the instruments and paid into the treasury.

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Central Office.—The office establishment on the 31st March 1884 consisted of the following clerks:—

Baboo Chandi Churn Chatterji, Head clerk.
 „ Purna Chundra Mukerji, 2nd „
 „ Bireswar Mukerji, 3rd „
 „ Kamini Mohun Bose, Tabulator.
 „ Joggeswar Roy, „
 „ Debendra Nath Banerji, „
 „ Rakhal Das Chuckerbutty, „
 „ Ashutosh Roy Chowdhuri, „
 „ Nibarun Chunder Chatterji, „
 „ Joti Lal De, „
 „ Nogendra Nath Paul, Draughtsman.

The amount of work which had to be done in connection with the extension of the system was much larger than I anticipated, and it was therefore necessary to employ temporary clerks for some months. Four were employed from 16th May to 15th July, and three from 16th July to 15th November.

The clerks generally have assisted zealously and intelligently in carrying out the extensions, and have worked very laboriously during the past year. Baboo Chandi Churn Chatterji has, as last year, been a most efficient head clerk. I desire also to place on record my recognition of the hard and useful work done by Baboos Kamini Mohun Bose and Debendra Nath Banerji, the former of whom was in charge of the rainfall registration and tabulation, and the latter of the preparation of the Bay of Bengal and Bengal Daily Weather Reports.

The following gives a brief summary of the work done by the office during the year:—

1. The correspondence which included 1,750 letters received and 2,440 letters issued, or 4,190 letters in all docketed and filed for reference. The following table will show the very large increase that has taken place in the office correspondence consequent on the extension and the rapid rate at which the correspondence has increased during the past two years:—

YEAR.	Letters received.	Letters issued.	Total number.
1879	621	579	1,200
1880	672	629	1,301
1881	601	635	1,236
1882	917	1,112	2,029
1883	1,750	2,440	4,190

2. The reduction and tabulation of the 10 A.M. and 4 P.M. observations taken at seven second class stations, and fifteen Imperial third class stations, and of the 10 A. M. observations taken at twenty-two Provincial third class stations, and also of the hourly observations taken on four days of each month at the following second class stations:—

Dhubri.	Patna.
Sibsagar.	Cuttack.
Hazaribagh.	Chittagong.

3. The entry of all the observations taken previous to the year 1883 at 18 stations in Bengal in books for reference, and in such a manner that the mean pressure, maximum or minimum temperature, and rainfall for any day of the year at any of these stations can be at once obtained. These are filed in four thick folio volumes, and the observations which continue to be taken are added, so that they form a continuous record of all the observations taken at each station, arranged in the simplest way for reference.

4. The entry of all the rainfall observations taken at the revenue stations filed in the office records into twenty-four large folio volumes in a similar manner to the preceding, so that the average rainfall for any day, or any week or month, or any other portion of a year, may be determined with the least possible labour.

5. The preparation of the Bengal daily weather report, from 15th May to 6th of November, and of the Bay of Bengal weather report during the year.

6. The preparation of the weekly and monthly meteorological and rainfall reports for the province published in the *Calcutta Gazette*.

7. The preparation of four sets of three rainfall charts monthly during the south-west monsoon period, 1883 (*i.e.*, from May to November), showing by colours—

- (1) the average distribution of rainfall over the province for the month;
- (2) the actual distribution of rainfall for the same month;
- (3) the variation of the actual from the average rainfall, indicating whether it was in excess or defect, and the amount.

The four sets were all drawn and coloured by hand. One set was forwarded about the 8th of the succeeding month (to that to which it referred) to His Honour the Lieutenant-Governor; a second set to the Secretary to the Government of Bengal in the Revenue Department; a third to the Sanitary Commissioner; and the fourth was kept for office reference.

8. Preparation of special returns and a special set of charts, illustrating the distribution and partial failure of the rains in Bengal during the south-west monsoon period of 1883 (*i.e.*, from May 15th to November 15th). These were submitted to the Secretary to the Government of Bengal in the Revenue Department, and were referred to in the Resolution of the Government of Bengal in the Revenue Department, dated 18th December 1883, in the following terms:—"These results are shown upon charts which have been prepared by the Meteorological Reporter to this Government. The Lieutenant-Governor would have been glad had time permitted of these charts being lithographed and published with this Resolution; for an inspection of them, and a perusal of the correspondence published herewith, would have shown in a striking manner the intimate relation which exists between deficient rainfall and crop failure. In fact, it may be said that the information supplied to Government by the Meteorological Reporter suggests practically the same conclusions which an examination of the local reports dictates."

9. The preparation of tables giving the average and actual rainfall, and the difference between the actual and average rainfall (or variation) for each month of the year 1883 and for the whole year at 166 rainfall-recording stations. These returns were published in the *Calcutta Gazette* of the 30th January 1884.

Storm-signals.—No very severe cyclone was generated in the Bay of Bengal during the year 1883. A number of smaller cyclonic storms occurred during the prevalence of the south-west mon-

soon over the Bay. They gave rise to strong winds and stormy weather, and in one or two cases to winds of hurricane force over a small part of the Bay, more or less dangerous to any ships involved in them near the centre. The following is a list of all those which are known to have occasioned wind and sea, trying, if not dangerous, to shipping:—

1. Storm of June 13th to 16th at the commencement of the south-west monsoon, and which gave the first heavy burst of rainfall to Behar. It formed near the Balasore coast on the 13th, and advanced into Behar where it broke up on the 20th.

2. Storm of June 26th to July 4th. This was generated slowly near the Sandheads on the 26th and 27th, and was of considerable intensity, and remained nearly stationary until the 29th. It crossed the Balasore coast early on the morning of the 30th.

3. Storm of July 6th to 8th. This was formed at or near the Sandheads under similar conditions to the preceding, but was of small intensity. It crossed the Balasore coast on the afternoon of the 7th.

4. Storm of the 12th to 14th of July. This began to form on the morning of the 12th off the south Orissa coast, across which (between False Point and Gopalpore) the centre advanced on the evening of the 13th, or early on the morning of the 14th, into the Central Provinces. It was of slight intensity.

5. Storm of the 16th to 18th of August. This was formed in the north-west angle of the Bay and crossed the north Orissa coast near Balasore. This storm was very small, and of very slight intensity, and of no importance.

6. Storm of the 23rd to the 26th of August. This was generated further to the south than the preceding storm, and crossed the Ganjam coast between Gopalpore and Vizāgapatam on the evening of the 25th. It was of slight intensity.

7. Storm of the 30th August to the 3rd of September. This depression crossed the coast near Balasore on the afternoon of the 2nd of September, and was of moderate intensity.

8. Storm of the 6th and 7th of September. This was formed immediately after the preceding, and followed along nearly the same track, crossing the Orissa coast to the south of Balasore on the morning of the 7th. It was of small intensity.

9. Storm of the 11th to the 15th of November. This was apparently generated in the Martaban Gulf, and advanced first in a north-westerly direction to latitude 16° N and longitude $93^{\circ} 45'$ E in the neighbourhood at Diamond Island, and then recurved slightly and moved northwards parallel to the coast and broke up in the neighbourhood of Akyab during the afternoon of the 14th. This was the most severe and intense storm of the year in the Bay, but was of very limited extent, and hence did not apparently affect the weather in the north-west angle of the Bay.

10. Storm of the 2nd to the 4th of December.

The above list of storms for the year 1883 presents two important peculiarities, which are both illustrations of generalizations and deductions, to which attention has been called in my cyclone reports. The first is the unusually large number of small cyclonic storms during the period when the south-west monsoon was in force at the head of the Bay and in Bengal. The south-west monsoon of last year was unusually weak, and terminated abruptly in the latter part of September. A weak monsoon is usually accompanied with heavier rainfall than usual near the head of the Bay, and with the consequent formation of a larger number of cyclonic storms or atmospheric whirls. The past south-west monsoon has apparently been a well marked illustration of this principle. The other important feature was the absence of storms during the period extending from the 15th of September to the 10th of November. After the abrupt termination of the south-west monsoon in Northern India, north-easterly winds set in almost immediately on the Coromandel Coast and gave heavy rain for several weeks, so that the commencement of the north-east monsoon in Madras last year was

the most favourable for agricultural operations which that presidency has experienced for some years. Heavy continuous rain on the Madras coast during the October transitive period is, as indicated by the condensation theory of cyclones, unfavourable to the formation of cyclonic whirls on the Bay at that time. Experience confirms this, and indicates that a strong north-east monsoon on the Madras coast, with heavy and more or less continuous rain over the land, is associated with

an absence of cyclones in the Bay. The past year was a remarkable example of this principle. The October transition period was characterised by unusually fine weather in the Bay, and by the non-occurrence of a single storm until the 11th of November, when rainfall ceased for some time in the Madras Presidency.

Nine of these storms, *viz.*, Nos. 1, 3, 4, 5, 6, 7, 8, 9, and 10, although giving strong winds and a high sea at Saugor Island, did not appear to be of sufficient intensity to warrant the hoisting of storm signals. Warning signals were hoisted for storm No. 2 only.

On the approach of this storm, bad weather signal No. 6 was hoisted at 11-30 A.M. on the 28th June, intimating that a small cyclonic storm was formed near the head of the Bay. This was changed on the receipt of further telegraphic weather reports to signal No. 8, at 1 P.M. of the same day, intimating that the storm was advancing from the Bay to the coast on the west of the Hooghly, or between Saugor Island and False Point. The storm signals were taken down at 2 P.M. on the 30th.

Daily Weather Reports.—As stated in my last report, the form of the Bay of Bengal daily weather report was altered at the commencement of the official year. The size of the sheet was reduced, a better quality of paper was used, and a chart and form lithographed for it at the Lithographic Department of the Surveyor General's Office. The new form of report was first issued on the 15th May. The character of the report was not altered, but advantage was taken of the establishment of an observatory at Balasore to increase slightly the number of the stations sending observations for this report. The report now furnishes observations taken at 17 stations on or near the coast of the Bay, together with a summary of the more important features of the weather as indicated by the observations, and a chart giving the distribution of pressure, air motion, and rainfall. This report was supplied to 29 subscribers and 30 Government officials at the commencement of the year, and to 29 subscribers and 32 Government officials at the end of the year. The receipts from subscription during the year covered the cost of printing and distributing the reports. There was a small balance of Rs. 160-5-6 at the end of the year 1883-84, which was kept in hand in order to meet any repairs to the lithographic presses.

The Bengal daily weather report was first issued on the 15th of May. The first reports gave observations taken at 14 stations, with a short summary. The number of stations was gradually increased by the establishment of the additional observatories, and from the beginning of August daily weather telegrams were received from 31 observatories, including 4 in Orissa, 6 in South-West Bengal, 4 in East Bengal, 6 in North Bengal, 4 in North Behar, 6 in South Behar, and 1 in Chutia Nagpur.

These reports were published and issued by the Bengal Secretariat Press, and were supplied to 94 Government officials and to 3 subscribers.

Copies of the weekly and monthly meteorological and rainfall returns (as published in the Gazette) were struck off for the convenience of the public, and were supplied at a charge just sufficient to cover the actual expense of printing and distribution.

Marine Meteorology.—A fair amount of work has again been done in this Department. In consequence of the unusually heavy work thrown upon me during the past year in carrying out the extensions required for the Bengal Government, and of my absence for three months on privilege leave, I was not able to do as much as I desired. Mr. Dallas has continued to work steadily at the charting of the barometer and wind data of the Bay, and has finished this work up to the month of June. Two hundred and fifty-three sets of returns, giving meteorological extracts from logs, were sent in to me by the captains of vessels arriving in the port. The officers of several steamers belonging to lines trading between Calcutta and England take special observations in the Bay and Arabian Sea on their way home and back again. Log-books have been sent to me on several occasions with permission to make any extracts that were required.

The results of the working of the past two years has shown, it seems to me, conclusively that a large amount of valuable meteorological information can be easily obtained from the captains of vessels navigating the Bay, and that the majority of captains and officers of vessels, from the interest they take in the weather, are ready, even at considerable trouble to themselves, to fill in the returns in the hope they may be of some use in the investigations of the Meteorological Department.

Although the number of returns sent in is smaller than were received last year, they have been of higher quality. A fair proportion of the observations have been as accurate and carefully taken, judging from internal evidence and from a comparison with the land observations on the coasts of the Bay, as at our best land observatories.

I have utilized the information they have supplied in preparing an account of the two most severe storms in the Bay during the year 1883, *viz.*, that at the head of the Bay in the last week of June, and that off the Burma and Arakan coast in the second week of November. It is intended to publish this and the cyclone reports which were nearly finished last year, during the present year.

In addition to the information derived from the meteorological extracts from the logs of vessels, meteorological observations were taken at 10 A.M. and 4 P.M. on board the light vessels near the mouth of the Hooghly.

The following gives the names of the vessels at which observations were taken, and the period during which they were recorded :—

	Station.	Period.
Floating Light Vessel "Star" . . .	Eastern Channel . . .	April 1883 to 30th March 1884.
" " "Meteor" . . .	Intermediate Station . . .	April to 8th October 1883.
" " "Foam" . . .	Mutlah Station . . .	November 1883 to March 1884.
" " "Comet" . . .	Long Sand Station . . .	September and October 1883, March 1884.
" " "Mermaid" . . .	Upper Gasper . . .	April to November 1883.
" " "Planet" . . .	Lower Gasper . . .	April to October 1883.
	Intermediate Station . . .	February 1884.
	Pilot Ridge Station . . .	10th July to 19th September 1883.
	Intermediate Station . . .	9th October to 30th November 1883.
	Upper Gasper . . .	1st December 1883 to 31st January 1884.

Financial Statement.—The following gives the expenditure on account of the Bengal Meteorological Department during the year 1883-84, and the total grants sanctioned by Government under each of the various heads :—

HEADS OF EXPENDITURE.		Actual expenses incurred during 1883-84.	Budget grant for 1883-84.
	Rs.	Rs. A. P.	Rs. A. P.
Meteorological Reporter's allowance	3,600	} 5,400 0 0	5,400 0 0
" Marine	1,800		
Office establishment	} Permanent Temporary	4,526 6 3	4,851 0 0
		400 15 5	400 15 5
Office rent		900 0 0	900 0 0
Observers	} Telegraph Masters Native Observers Provincial Observers	2,100 0 0	} 9,240 0 0
		4,440 0 0	
		2,131 4 10	
Messengers' allowance		62 14 5	100 0 0
Allowance to Superintendents of observatories		1,440 0 0	1,440 0 0

HEADS OF EXPENDITURE.	Actual Expenses incurred during 1883-84.	Budget Grant for 1883-84.
	Rs. A. P.	Rs. A. P.
CENTRAL OFFICE.		
Contingent and office furniture	792 9 0	1,140 0 0
Postage	1,693 4 9	4,000 0 0
Telegraphic messages	12,199 4 0	19,000 0 0
Travelling allowances	1,423 7 0	1,780 0 0
OBSERVATORIES.		
Building and repairs	1,093 3 6	2,550 0 0
Contingent	91 7 6	98 0 0
TOTAL	38,694 12 8	50,899 15 5

The amount is Rs. 11,898-15-4 in excess of the actual expenditure of last year, but Rs. 12,205-2-9 less than the sanctioned grant. The savings have been mainly under the head of telegraphic messages, postage, and payments to provincial observers. The amount of the Bengal Provincial grant was calculated on the supposition that the new observatories would be in working order on the 1st April. Hence as the majority of them were not established until the middle of June or beginning of July, there was a considerable saving in the amount of payments to observers, and also under the head of telegraphic messages or weather telegrams. The transmission of observations by telegram and post under the extended system has also, in consequence of the ready co-operation of the various officials and the almost exclusive use of postal cards in place of the meteorological forms such as have hitherto been employed, been less expensive than I anticipated, and I have therefore proposed to Government that a portion of the Bengal Provincial grant, which would otherwise lapse yearly, be utilized to provide for certain additional observatories which are much needed to give additional information, and for a further increase of my office establishment.

There is apparently a large saving under the head "Building and repairs;" but this is, so far as I can ascertain, not real, but due to the fact that the cost of several of the new observatories has not been debited yet against the Meteorological Department by book transfer between it and the Public Works Department.

The figures in the statement give the total expenditure so far as can be at present ascertained by my office.

The statement does not include the cost of instruments supplied to the observatories by the Indian Meteorological Department, nor of the cost of stationery supplied to the Central Office, nor of the cost of printing the meteorological returns given in the Gazette or otherwise, or the forms required in the Meteorological office, by the Bengal Secretariat Press.

JOHN ELIOT, M.A., F.M.S.,
*Meteorological Reporter to the
Government of Bengal.*

METEOROLOGICAL OFFICE, BENGAL;
The 29th April 1884.

APPENDIX B.

Extracts from the Administration Report of the Meteorological Reporter to Government, North-Western Provinces and Oudh, for the year 1883-84.

The changes which have taken place during the year 1883-84 have been that the Reporter, Mr. S. A. Hill, took furlough from the 20th May 1883. At first Mr. Hill intended to have been absent one year only, but since he has been at home he has had the period extended by five months, and will not, therefore, rejoin his appointment till the 20th October. During Mr. Hill's absence I (Dr. Murray Thomson) have officiated as Reporter. The only other important change has been the abolition of the observatory at Paori, Garhwal. This observatory originated in the offer of the Missionary stationed there to take observations if instruments were supplied to him. After some time a small monthly allowance was paid to the observer; but, as there was no budget provision for the allowance, Mr. Hill very generously paid it out of his private funds, but it was discontinued when he left India. It was then found impossible to carry on the observatory without an allowance, and it was, therefore, resolved to remove the instruments, which was accordingly done. This is the less to be regretted as the Kumaon district has still two observatories—one at Ranikhet and one at Pithoragarh.

The following table shows the observatories which send records to this office and states how they are maintained. In the Appendix B II will be found a list of the Superintendents and the observers at these observatories:—

HOW MAINTAINED.	Class.			
	I.	II.	III.	
By Meteorological Department	Allahabad (in abeyance).	Allahabad. Lucknow. Agra. Roorkee.	Chakráta. Ránikhet. Pithoragarh. Bareilly. Gorakhpur. Benares. Sutna. Jhánsi. Ajmere. Sambhar.	
By other Government Departments.				Dehra. ¹ Ghazipur. ² Meerut. ⁴ Nowgong. ⁵
Voluntarily by independent States, &c.	Jeypur. ³			

¹ Maintained by Survey Department.

² Ditto Opium Agency.

³ Ditto State Darbar.

⁴ Maintained by Municipality.

⁵ Observer unpaid.

FIRST CLASS OBSERVATORIES.

The only observatory of this kind which is fully equipped is that at Jeypur. The preceding table shows that this is maintained by the Jeypur Darbar.

A special report on the working of this observatory during the past year has been furnished by its acting Superintendent, Surgeon C. W. Owen, C.I.E. Some extracts from this report will be given further on (Appendix B I). As has more than once been stated in these reports, it is intended to have a first class observatory at Allahabad, and the self-recording instruments intended for it have been lying unused in Calcutta for many months. All that is wanted is a suitable building in which to erect them. Sanction had been obtained to the greater part of the cost of this building, and a site had been fixed on, and a piece of suitable ground had been given, and the plans were prepared, when it was found necessary by the Government of the North-Western Provinces to withdraw sanction to the expenditure of the previously allotted money in favour of more urgent public works. This necessity is deeply to be regretted, as already the building of this observatory has been postponed from various causes for now over two years.

Allahabad is still worked as a second class station, and furnishes a very full set of observations. The observer has worked well during the past year, and the personal extra allowance of Rs. 10 per mensem is to be continued to him.

At present two of the instruments are, for want of a better site, exposed on the roof of the building now used as the Muir College, which is nearly a mile from the present main observatory. This is a very inconvenient arrangement, and I have requested sanction for the erection of a small tower, 30 feet high, near the present observatory, on which to place the instruments just mentioned and have them within easy reach.¹

It was mentioned in last report that an experimental observatory had been set up in the grounds of the new Muir College in order to anticipate the effect on the observations by the removal of the instruments to a more open site. A table giving a comparison of the observations made at this new site with those made at the old was given in the last report, and a continuation of this table is given in this report.² As this experimental observatory has now served its purpose, observations at it have been discontinued since the 31st March of this year.

The underground temperature observations made with thermometers placed at half-an-inch, one foot, and three feet below the surface, have been continued during the past year.

* * * * *

SECOND CLASS OBSERVATORIES.

Lucknow.—There is very little to add to the remarks made on this observatory in the last report. A glass-case to protect the clock-work of the anemograph has been made. During an unofficial visit made to Lucknow in January last I went over the observatory and found all the instruments in good order; but a cover for the clock-work was much wanted, and I requested that one should be made for it. The observer here is an intelligent man, and has again rendered a good year's work: so he retains for another year the personal extra allowance of Rs. 10 a month.

Agra.—The only remark to be made on the observatory here is that the reading of the instruments is well and punctually done, but there is no improvement on the registers sent in. A good many corrections on errors in the computation have to be made. On account of this want of improvement I did not recommend the restoration of the full personal extra allowance. The observer will, therefore, for another year at least draw the minor allowance only.

Roorkee.—I inspected this observatory in October last and found all the instruments clean and in good order. The large Adie's barometer is still in use. A small portion of the inner surface of the tube has got fouled; several attempts to clear the tube have been made, but without success. Fortunately, the reading of the mercury level can still be made; and with accuracy, if care is taken. If this fouling of the tube increases, there is another compared barometer ready to take the place of the older one, so that there will be no discontinuity of the observations.

The observer here is a hard-working man, and is fairly neat and very punctual in his returns, and his computing work has greatly improved. * * * * *

THIRD CLASS OBSERVATORIES.

Chakráta.—This station was inspected by me in October last. I found the instruments in good order and well situated, except the rain-gauge, the position of which I had altered so as to secure a freer exposure. At the time of my visit the observer, Salig Ram, stated that he was to be transferred to another Division of the Military Works (he is a draughtsman in the Office of the Executive Engineer of Military Works, and the latter is Superintendent of the observatory), but I am glad to be able to report that no change has been made. As this observer has worked well, his personal allowance of Rs. 5 has been continued for another year.

Meerut.—I visited this station in October last and found that all the instruments had been well cared for. The observer can be quite accurate in his reading of the instruments, but he is not always so. A bad instance of this occurred last December, when he sent in for the daily telegraphic report a

¹ Since the above paragraph was written Government has sanctioned the cost of this tower.

² Not reproduced here.—H. F. B.

series of wrong readings of the barometer: in them the error was found to depend on faulty adjustment of the fiducial point in the cistern of the instrument. When attention was called to this fault more correct readings were immediately rendered.

While visiting Chakráta, Roorkee, and Meerut, I also visited the observatory at Saint Fidelis' School in Mussooree. This station reports directly to the Reporter with the Government of India, and it was at the request of the latter that I made this inspection, for this observatory does not come under the supervision of the local Reporter. I was not at all pleased with the arrangements I saw. The instruments are well exposed, but they looked dirty and not over carefully attended to. A European youth of about 15 or 16 years of age was the observer. It was obvious he was not much impressed with the importance of being either accurate or punctual, although, I dare say, he would not intentionally send in erroneous work. Father MacCarthy, the Superintendent, put in a claim for a monthly allowance. I supported this claim, but with the proviso that, if given, it might be withdrawn at any time if careless work was rendered.

OTHER OBSERVATORIES.

There are no remarks to be made on any other of the observatories. The work in them all, so far as can be judged from the returns sent, has been done with a fair amount of accuracy and punctuality.

* * * * *

RAINFALL REGISTRATION.

The chief stations in all districts of the North-Western Provinces and Oudh are now supplied with rain-gauges of the Symon's pattern, but the subordinate stations still use the float and rod gauge.

The number of places which send in rain registers is 253. A separate annual report for the calendar year 1883, giving monthly and annual totals, was compiled in this office and published as a supplement to the Government Gazette of 29th March last.

A new edition of Mr. Hill's paper "On the Rainfall of the North-Western Provinces and Oudh" was published last year and was illustrated with a well-executed map.

* * * * *

INSTRUMENTS.

Full details as to instruments issued to the various observatories are given in Appendix ¹ and those broken in Appendix B III. * * * The number of breakages is very small, and is mostly confined to the exposed thermometers—sun and grass radiation. The anemometer entered for Agra as broken was really worn out and was no longer fit for use.

STATEMENT OF EXPENDITURE.

This will be found in Appendix B V. The total expenditure is larger by Rs. 375 than in the previous year. This is accounted for by the entertainment of an additional clerk on Rs. 15 a month and the pay of all the clerks in the Reporter's office was increased by Rs. 5 a month for each clerk. The sanction of Government was obtained to the increase of expenditure for the purposes just mentioned.

OFFICE AND OFFICE WORK.

There is nothing to enter under this head, except that sanction was obtained from Government, as already mentioned, to the employment of an additional clerk on a salary of Rs. 15 a month. The establishment in the Reporter's office, as it now stands, is as follows:—

Chintamony Ghosh, head clerk	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Rs.
Kaliprosono Datta, 2nd "	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	92
Makhan Lal Mookerji, Tabulator	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	55
Ram Charan Pande, Ditto	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	35
Sasi Bhusan Banerji, Ditto	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	25
Ashutosh Bose, Ditto	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	25
One peon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15
One daftri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
																		7
																		260

No special work has been attempted this year, but the ordinary work has been well done.

¹ This is incorporated in the general return in Appendix K.

APPENDIX B I.

Extracts from Report on Observatory at Jeypur, by SURGEON C. W. OWEN, C.I.E.

“METEOROLOGICAL OBSERVATORY, JEYPUR.”

Two new instruments have been added during the year, *viz.*, the Nephescope and the Sunshine Recorder.

The compound walls have been thoroughly repaired, the railings painted, the meteorograph tower re-coloured, new steps provided : in fact, the whole observatory has been thoroughly done up.

A great improvement has been effected in the meteorograph room by removing the battery to a separate room, where there is a more equable temperature.

Sheds have been built for the observers and new thatch has been placed on the guard and thermometer sheds.

All these repairs and improvements have been carried out without any extra expense to the Darbar.

List of Staff—

Durga Parshad	. . . . .	1st observer.
Nathu Narain	. . . . .	2nd ditto.
Hurbux	. . . . .	3rd ditto.
Hardeo	. . . . .	Pcon.

Mr. Callaghan, the Electrician, has been of the greatest service during the year, and my best thanks are due to him for his ready assistance at all times. Daily weather telegrams have been despatched throughout the year to Simla and Calcutta.

Osler's anemograph.—This instrument, which forms a continuous register on metallic paper wrapped round the drum of the instrument, shows the direction, velocity, and force of the wind, and has been working nearly accurately throughout the whole year. The rainfall registered by this instrument during the year was 19.47 and the prevailing wind was north-west.

Nephescope.—This instrument is a new invention and consists simply of a glass mirror with the cardinal points marked on it and fitted with an iron pointer, so that the direction of movement of the upper-strata air can be noted by watching in which direction the clouds move from the fixed pointer.

This glass is placed on a marble column, on which the true magnetic North is marked. When exposed it distinctly reflects the whole sky ; so that one can easily ascertain in what direction a particular cloud moves without the eyes being in the least dazzled by the intense light of the sun.

Sunshine recorder.—This instrument, which has lately been received, consists of a perfect globe of crystal, set in a stand and supported between two concave-surfaced screws, and is provided with a moveable arc, which requires adjustment according to the season of the year.

When exposed, a card of coloured paper with the gradations of hours marked on it from 6 A.M. to 6 P.M. is placed in the segment of the circle underneath the ball, and the rays of the sun are focussed on the middle of the scale, which chars the paper as long as the sun shines.

This charred line shows the hours during which the sun shone. It has been in use from the 1st of February 1884.

Meteorograph.—The working of this instrument during the year was on the whole satisfactory.

The instrument stopped on a few occasions, caused, firstly, by the warping of the wood fixed to the back of the cabinet, to which the different instruments are attached; secondly, the failure of battery power owing to imperfect porous pots procured in India and from England.

These imperfections have since been removed, first, by brass connections screwed to the detached pieces of wood; and secondly, by replacing the Daniel by a Menotti battery. This change was made on 1st November 1883, and it has worked very well since. It is presumed that this battery will last for another twelve months. The anemometer is the only portion of the instrument that gives trouble; the mechanism is so delicate that it frequently gets out of order, owing to the breakage of the delicate contact springs. These have been several times replaced and as often broken. We are now working it with light steel springs as a temporary arrangement until such a time as those indented for from Belgium arrive. Great difficulty was experienced in printing from the etched plates, owing to the want of a suitable press, and also owing to the etching not being sufficiently deep. A lithographic press is now in use adjusted to the pressure required, and the printing from this is as good as can be expected. We have begun to take very good impressions from 1st October 1883.

All the instruments that make up the meteorograph, except the anemometer, are in good working order, and the rainfall as registered by this instrument during the year 1883 was 20·85 inches.

APPENDIX B II.

Names of the Superintendents and of the Observers at the Meteorological Observatories in North-Western Provinces and Oudh during the year 1883-84.

Observatory.	Class.	Officer in charge.	DATE.		Observers.	DATE.	
			From	To		From	To
Allahabad . . .	Second	S. A. Hill, Esq. . . Dr. Murray Thomson . . .	1st April, 1883. 16th May, 1883 . . .	15th May, 1883 . . . 31st March, 1884 . . .	Kedar Nath Chaterji, Observer . . Jadu Nath Chaterji, Observer at the new Observatory . . . Bhola Nath Chaterji . . . Sasi Bhusan Banerji, Assistant Observer . .	1st April, 1883 . . Ditto . . . 24th August, 1883 . . 1st April, 1883 . .	31st March, 1884. 23rd August, 1883. 31st March, 1884. Ditto.
Agra . . .	Ditto	„ A. H. Hilson . . .	1st April, 1883 . . .	Ditto . . .	Mir Altaf Ali, Observer . . . Abdul Majid Khan, Assistant Observer . .	Ditto . . . Ditto . . .	Ditto. Ditto.
Lucknow . . .	Ditto	„ J. C. Whishaw . . . „ J. Cameron . . .	Ditto . . . 6th February, 1884 . . .	5th February, 1884 . . . 31st March, 1884 . . .	Chotey Lal, Observer . . . Durga Parshad, Assistant Observer . .	Ditto . . . Ditto . . .	Ditto. Ditto.
Roorkee . . .	Ditto	Murray Thomson . . . Lieut. G. Onslow, R.E. . .	1st April, 1883 . . . 16th May, 1883 . . .	15th May, 1883 . . . 31st March, 1884 . . .	Cheranji Lal, Observer . . . Tulsee Ram, Assistant Observer . . Jug Mohan Lal, Assistant Observer . .	Ditto . . . Ditto . . . 15th October, 1883 . .	Ditto. 14th October, 1883. 31st March, 1884.
Jeypur . . .	First	Surgeon-Major Hendley . . . Surgeon C. W. Owen, C.I.E. . .	1st April, 1883 . . . 23rd April, 1883 . . .	22nd April, 1883 . . . 31st March, 1884 . . .	Durga Parshad, Observer . . . Nathu Narain, Observer . . . Hurbax, Observer . . .	1st April, 1883 . . Ditto . . . 1st July, 1883 . .	Ditto. Ditto. Ditto.
Chakrata . . .	Third	Captain A. C. Ward . . .	1st April, 1883 . . .	Ditto . . .	Saligram . . .	1st April, 1883 . .	Ditto.
Paori . . .	Ditto	Rev. J. T. McMahon . . .	Ditto . . .	30th Nov., 1883 . . .	Rev. F. W. Greenold . . .	Ditto . . .	30th Nov., 1883.
Pithoragarh . . .	Ditto	„ Dr. R. Grey, and Rev. Buck . .	Ditto . . .	31st March, 1884 . . .	Sher Singh . . .	Ditto . . .	31st March, 1884.
Ranikhet . . .	Ditto	No Superintendent . . .	.....	.....	Jewa Nund . . .	Ditto . . .	Ditto.
Dehra . . .	Ditto	Deputy Supdt., Survey of India . .	1st April, 1883 . . .	31st March, 1884 . . .	The Head Computers . . .	Ditto . . .	Ditto.
Meerut . . .	Ditto	Dr. W. Moir . . .	Ditto . . .	Ditto . . .	Harsaran Das . . .	Ditto . . .	Ditto.
Bareilly . . .	Ditto	E. A. Phillips . . .	Ditto . . .	Ditto . . .	Jwala Parshad . . .	Ditto . . .	Ditto.
Gorakhpur . . .	Ditto	Dr. C. Prentis . . .	Ditto . . .	Ditto . . .	Nizam-ud-din . . .	Ditto . . .	Ditto.
Benares . . .	Ditto	Principal, Benares College . . .	Ditto . . .	Ditto . . .	Deokinandan Patak . . .	Ditto . . .	Ditto.
Ghazipur . . .	Ditto	Dr. P. A. Weir . . .	Ditto . . .	Ditto . . .	Babu Kunjan . . .	Ditto . . .	Ditto.
Sutna . . .	Ditto	Agency Surgeon . . .	Ditto . . .	Ditto . . .	Harnath . . .	Ditto . . .	Ditto.
Nowgong . . .	Ditto	A. P. Mitchel, Esq. . .	Ditto . . .	Ditto . . .	.....	.....	.....
Sambhar . . .	Ditto	W. Poneter, Esq. . .	Ditto . . .	Ditto . . .	J. Romare . . .	1st April, 1883 . .	31st March, 1884.
Jhansi . . .	Ditto	Surgeon-Major Eades, Dr. Simmonds .	Ditto . . .	Ditto . . .	Kalka Das . . .	Ditto . . .	Ditto.
Ajmere . . .	Ditto	Dr. J. H. Newman . . .	Ditto . . .	Ditto . . .	Ram Parshad . . .	Ditto . . .	Ditto.

APPENDIX B III.

Return of Instruments broken or otherwise injured at the Observatories in N.-W. Provinces and Oudh during the year 1883-84.

STATION.	Solar thermometer.	Maximum thermometer.	Grass thermometer.	Anemometer.	Solar thermometer stand.	Earth thermometer.	Wet bulb of hygrometer.	REMARKS.
Chakrata	I.	...	...	...	...	...	...
Ranikhet . . . .	...	I	...	...	...	...	...
Agra . . . . .	...	...	I	I	...	...	...
Lucknow	I	...	...	...	I	...	...
Allahabad new observatory	...	...	...	...	...	2	...	
Benares . . . . .	...	...	I	...	...	...	...
Sambhar	I	...	...	...	...	...	2	
Ajmere . . . . .	...	...	I	...	...	...	...
Gazipur . . . . .	...	...	I	...	...	...	...

APPENDIX B IV.

Results of Underground Temperature Observations at Allahabad.

MONTH.	SURFACE.				ONE FOOT DEEP.				THREE FEET DEEP.				MEAN TEMPERATURE.			
	4 h.	10 h.	16 h.	22 h.	4 h.	10 h.	16 h.	22 h.	4 h.	10 h.	16 h.	22 h.	Air in shade.	Ground surface.	One foot deep.	Three feet deep.
April 1883 .	77°0	101°8	102°9	84°3	86°4	85°3	86°3	87°7	81°9	81°9	82°1	82°1	88°9	91°5	86°4	82°0
May „ .	83°2	106°9	106°5	89°8	92°8	91°8	92°6	93°8	88°0	88°0	88°1	88°0	94°1	96°6	92°8	88°0
June „ .	85°5	98°8	98°4	89°1	91°7	90°9	91°8	92°4	89°4	89°2	89°4	89°4	91°3	93°0	91°7	89°4
July „ .	83°3	88°3	90°5	85°5	87°4	86°8	87°0	87°6	87°4	87°3	87°4	87°3	84°8	86°9	87°2	87°4
August „ .	83°6	90°3	93°6	86°3	88°1	87°7	88°0	88°7	87°3	87°3	87°4	87°4	85°9	88°4	88°1	87°4
September „ .	81°5	90°1	91°3	87°2	86°9	86°4	86°8	87°4	87°1	87°0	87°1	87°1	83°1	87°5	86°9	87°1
October „ .	72°7	87°5	90°2	76°7	82°0	81°3	82°1	82°7	84°2	84°2	84°3	84°2	77°4	81°8	82°0	84°2
November „ .	60°7	75°4	82°0	65°8	73°0	72°5	73°2	73°8	78°0	77°9	78°2	78°0	66°0	71°0	73°1	78°0
December „ .	52°2	64°2	74°5	57°6	64°6	64°1	54°7	65°7	70°6	70°6	71°0	70°9	57°9	62°1	64°8	70°8
January 1884 .	55°0	65°8	77°3	60°7	65°7	65°0	65°5	66°8	69°0	69°0	69°4	69°3	61°0	64°7	65°8	69°2
February „ .	58°3	70°7	82°2	65°2	69°0	68°2	68°9	70°3	70°8	70°8	71°1	71°1	65°0	69°1	69°1	71°0
March „ .	71°0	90°9	97°7	78°1	80°1	79°3	80°0	81°6	77°8	77°9	78°1	78°1	80°1	84°4	80°2	78°0
Year .	72°0	85°9	90°6	77°2	80°6	79°9	80°6	81°5	81°0	80°9	81°1	81°1	77°9	81°4	80°7	81°0

APPENDIX B V.

Statement showing the expenditure of the North-Western Provinces Meteorological Department for the year 1882-83 (not including stationery, printing, or cost of instruments).

STATION.	IMPERIAL SERVICES.			
	Establishment.	Contingencies.	Reporter's travelling allowances.	Total.
	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Meteorological Reporter	3,000 0 0	...	307 12 0	3,307 12 0
Ditto Office	3,105 14 0	†1,256 6 6	...	4,362 4 6
Allahabad Observatory	720 0 0	...	...	720 0 0
Ditto New observatory	*180 0 0	...	...	180 0 0
Agra Observatory	900 0 0	25 0 0	...	925 0 0
Roorkee ditto	900 0 0	14 15 0	...	914 15 0
Lucknow ditto	1,020 0 0	23 4 6	...	1,043 4 6
Chakrata ditto	240 0 0	...	...	240 0 0
Ranikhet ditto	300 0 0	...	...	300 0 0
Pithoragarh ditto	180 0 0	...	...	180 0 0
Bareilly ditto	180 0 0	...	...	180 0 0
Gorakhpur ditto	180 0 0	‡4 8 0	...	184 8 0
Benares ditto	240 0 0	...	...	240 0 0
Jhansi ditto	180 0 0	...	...	180 0 0
TOTAL	11,325 14 0	1,324 2 0	307 12 0	12,957 12 0

* Temporary establishment for taking meteorological observations at the new observatory.

† Including office rent, charges for repairs to the observatories, and general contingencies of the Meteorological office and Allahabad observatory.

‡ Excluding charges for weather telegrams.

APPENDIX C.

Administration Report of the Meteorological Reporter to the Punjab Government for the year 1883-84.

The work of the Punjab Meteorological department in the past year has been carried on as usual. No change has been made in any of the observatories, which remain as follow :—

Lahore, Ludhiana, Simla, Delhi, Sirsa, Dera Ismail Khan, Multan, Sialkot, Rawalpindi, Murree, Peshawar, and Leh (Ladakh).

2. All of them, except Lahore and Leh, work as 3rd class; Leh and Lahore serve as 2nd class observatories. The position of the Lahore Observatory is faulty, but a better site is in contemplation by the Punjab Government, and the observatory will shortly be raised to a first class one.

3. As a second class station, Lahore registers 5 sets of daily observations, in addition to those registered here hourly, on 4 days in a month, *i.e.*, on 7th, 14th, 21st, and 28th of every month.

The observatory is under my daily supervision, in charge of Babu Jaspat Rai, the chief observer, and the condition of the observatory and good state of preservation of the instruments are due to the care of this observer.

4. The staff of the observatory, as in previous years, consists of an observer and assistant observer on a salary of Rs. 30 a month.

In addition to the routine work of the observatory, the observer in charge furnishes daily information of weather and climate to the *Civil and Military Gazette*.

INSPECTION.

5. During the year under report the observatories at Ludhiana, Simla, Delhi, and Sialkot were inspected and found to be in excellent order. The general character of the work of the observatories is very satisfactory.

I have little or no complaint against any of the observers. It was my intention to inspect all the observatories in the Punjab during the rains in the month of August, which is one of the vacation months at the Medical College; but last year the rain failed altogether in August and it was too hot to travel about in the plains; while in September I could not leave Lahore. The work of inspection is so important that I should like to make my chief observer, who is a reliable man, travel about inspecting the observatories at least twice every year.

6. All the observers selected for meritorious allowance during the year 1883-84 retained their allowance for the ensuing year. One of the observers, who was deprived of his meritorious allowance last year on account of laxity in his work, has been restored to the list of merit again, and will get Rs. 5, the increased allowance, in the ensuing year.

7. The office work is steadily increasing year by year, and on this account the engagement of a 3rd clerk was necessary during 1883. But, as we have taken in hand the computation of vapor tension and the making of duplicate copies, &c., which was done in the Head Office, Calcutta, heretofore, the addition of a new clerk has not given much relief to the existing pressure. The work is still in excess, and is too much for a small staff like ours.

8. The establishment of the Punjab Meteorological Office stands as follows :—

	Rs.	a.	p.
1 Head Clerk	50	0	0
1 Second Clerk	15	0	0
1 Third Clerk	15	0	0

9. During the year the Meteorological Office was removed from the Medical College, where it had been located since that building was opened, to new premises in the site of the old Dāk Bungalow. This arrangement is extremely inconvenient for the observers, who are also the office clerks, as the office is now nearly half a mile away from the observatory. I believe and hope that it is intended to increase the office establishment and raise the observatory to first class rank, and at the same time the present objectionable site of the observatory is to be abandoned and a new one is to be secured. In the new building the office will be attached to the observatory, and the work of both will be much facilitated.

10. The usual statements are herewith appended.

E. LAWRIE, M.B.,

Meteorological Reporter for Punjab Government.

LAHORE;

The 11th June 1884.

APPENDIX C II.

Table showing the Names of the Superintendents and Observers at the Meteorological Observatories in the Province of Punjab during the year 1883-84.

No.	Observatories.	Class.	Names of Superintendents.	PERIOD.		Name of Observer.	PERIOD.		ALLOWANCE.	
				From	To		From	To	Monthly allowance.	Meritorious allowance.
1	LAHORE	III	Ed. Lawrie, M.B., Meteorological Reporter, Punjab	Through out	Through out	Jasput Rai, Chief Observer Dewan Chund, Assistant	Through out	Through out	20 10	5 5
2	PESHAWAR	III	Surgeon W. Coates, M.D. " M. O'Dwyer, M.B. " T. E. L. Bate	1st April 1883 18th April " 1884 19th Feb. 1884	17th April 1883 15th Feb. 1884 31st Mar. "	Kashi Ram, Observer	Through out	Through out	15	5
3	MURREE	III	Rev'd. G. C. Peake	Through out	Through out	Mr. Cruickshank	Through out	Through out	15	5
4	SIALKOT	III	Dr. Thomas S. Veele " G. J. Shoud	1st April 1883 15th Oct. "	14th Oct. 1883 31st Mar. 1884	Futteh Singh, Assistant Surgeon Purma Nand Futteh Singh Sada Nand	1st April 1883 6th July " 1883 14th Oct. " 1883 14th Dec. " 1884	15th July 1883 13th Oct. " 1883 13th Dec. " 1883 31st Mar. 1884	15	
5	MULTAN	III	Surgeon-Major J. Bennett, M.D. " P. R. Mulroney, M.D.	1st Mar. 1883 28th Mar. 1884	27th Mar. 1884 31st Mar. "	Mr. Wahid Ali	Through out	Through out	15	
6	DEERA ISMAIL KHAN	III	Surgeon P. de. H. Haig M. C. Cartin Surgeon-Major A. P. Holmes	1st April 1883 24th Oct. " 1883 10th Dec. "	23rd Oct. 1883 9th Dec. " 31st Mar 1884	Nur Buksh Moshin Ali Nur Buksh	1st April 1883 22nd May " 1883 19th June "	21st May 1883 18th June " 1883 31st Mar. 1884	15	
7	SIRSA	III	R. Crossley, Civil Surgeon	Through out	Through out	Shamsunder Lall Fazal Rahman	1st April " 1883 25th April " 1884	24th April 1883 31st Mar. 1884	15	5
8	DELHI	III	Surgeon-Major G. C. Ross, Civil Surgeon.	Through out the year	Through out the year	Asst.-Surgeon Ramkishan Pandit Bansu Dhur	1st April " 1883 24th July " 1883	23rd July 1883 31st Mar. 1884	15	
9	SIMLA	III	Quartermaster General in India	Through out	Through out	Sergeant J. J. Kongs	28th May " 1883	31st Mar. "	15	
10	LUDHIANA	III	Dr. Rouse, Civil Surgeon	Through out	Through out	Asst. Surgeon Bhagwan Das Asst.-Surgeon Radlia Singh Asst.-Surgeon Bhagwan Das Asst.-Surgeon Sada Nand Asst.-Surgeon Bhagwan Das	1st April " 1883 11th May " 1883 18th July " 1883 1st Aug. " 1883 28th Oct. " 1884	10th May 1883 17th July " 1883 28th July " 1883 27th Oct. " 1883 31st Mar. 1884	15	
11	RAWALPINDI	III	Dr. G. Massy " T. R. Mulroney " G. Massy	1st April 1883 15th April " 1884 15th June "	14th April 1883 14th June " 30th Mar. 1884	Asst.-Surgeon Bhagwan Das	Through out	Through out	15	

E. LAWRIE, M.B.,
Meteorological Reporter for the Govt. of Punjab.

APPENDIX D.

Extracts from the Administration Report of the Sanitary Commissioner, Central Provinces.

1. I only took charge in December 1883, and so inspected only the Seoni Observatory. I found it in good order.

2. The observatories remained the same as in 1882.

3. *Nagpur*.—Observer's conduct good.

4. *Jubbulpore*.—The Superintendent reports more favourably of the observer, but still is not sufficiently satisfied to recommend him for enhanced pay.

5. *Pachmarhi*.—The Superintendent was transferred to another station, so there is not any report on the observer's conduct.

6. *Chanda*.—The observer is well reported of. The Superintendent was changed thrice during the year.

7. *Saugor*.—The observer was most unfavourably reported of, and has, since the close of the year, absconded. The Superintendent was thrice changed.

8. *Seoni*.—The observer is, as on former occasions, well spoken of, and the Superintendent would be glad to see his pay increased.

A series of readings of a maximum and minimum thermometer, placed on an island in the middle of a large tank, were made during the whole year, for comparison with those taken in the observatory. The Superintendent summarises the observation thus :—

“It is thus shown that the minimum temperature was lower during the hot weather, owing to “evaporation: and higher in the other 3 quarters, owing to the water retaining the heat longer than “the land; these temperatures represent the condition at night.

“The day or maximum temperature was higher on the island in the cold months and lower in the hot months for similar reasons—retention of heat when there was little evaporation and absorption of heat from the air during evaporation.

“The island is about 800 yards from the observatory.”

9. *Hoshangabad*.—There is nothing to note regarding this station, except that the conduct of the observer was good.

10. *Khandwa*.—A new barometer room was finished and the barometer moved into it on the 1st July. The meteorological shed was re-roofed and wire fencing placed round it. The observer is well reported of. The Superintendent was once changed during the year.

11. *Raipur*.—The barometer was moved during the year and the Superintendent reports its present position as “all that can be desired.” The observer's conduct is well reported of.

12. *Sambalpur*.—A second shed was erected on the old parade ground, near the bomb-proof magazine, which is now the barometer-room; the anemometer and rain-gauge were also moved up to this site, which is open and free from trees and buildings. The old shed by the jail was repaired. The old instruments remain in the old shed and comparative observations have been taken since the 16th October last. In the new shed the following instruments were brought into use :—

Hygrometer, dry bulb; hygrometer, wet bulb; dry maximum thermometer; dry minimum thermometer; wet minimum thermometer; grass radiation thermometer; sun radiation thermometer; rain-gauge; and a barometer received on the 11th July was brought into use in the new room on the 16th October.

The Observer, Shamsoondur Dass, is well reported of. A second observer, Hospital Assistant Syed Mahomad Hydar Hussain Hydar, of the Jail Hospital, was entertained on the 16th October, and is said to observe regularly and correctly.

13. *Sironcha*.—The observer is well reported of. The Superintendent was once changed.

14. The usual statements are annexed.

NAGPUR,
The 3rd May 1884.

JAMES H. LOCH, M.D.,
Offg. Deputy Surgeon-General and
Sanitary Commr., Central Provinces.

APPENDIX D II.

Names of the Superintendents and Observers at the Meteorological Observatories in the Central Provinces during the year 1883-84.

Observatory.	Class.	Officer in Charge.	DATE.		Observers.	DATE.		REMARKS.
			From	To		From	To	
Nagpur . . .	Second	Surgeon-Major R. T. Wright, M.D. .	1st April 1883	31st Mar. 1884	T. V. Allagheri Swamy . . . <i>Assistant Observer.</i>	1st April 1883	31st Mar. 1884	
Jubbulpore . .	Ditto	Surgeon-Major W. R. Rice, M.D. .	1st April "	31st Mar. "	T. Soobiah . . . Pandit Saduram Dubay . . . <i>Assistant Observer.</i>	1st April "	31st Mar. "	
Pachmarhi . .	Ditto	L. Gordon, Esq. The appointment of Superintendent was vacant . . .	1st April "	31st Jan. "	Hospital Assistant Kunji Behari Lal . Madho Rao . . . Kesho Rao . . . <i>Assistant Observers.</i>	1st April "	31st Mar. "	
Saugor . . .	Third	Surgeon-Major E. O. Tandy . . . Surgeon-Major J. W. Strong . . .	1st Feb. 1884	31st Mar. "	Kesho Rao . . . Luxmun Rao . . . Yado Rao . . . The appointment of observer was vacant . . .	1st April 1883	31st Jan. "	
Hoshangabad .	Ditto	Surgeon-Major E. O. Tandy . . . Surgeon S. H. Browne, M.D. . .	27th June "	31st Mar. 1884	Deevayal . . . Jadunath Bose . . .	1st April 1883	6th Mar. "	
Khandwa . . .	Ditto	Surgeon-Major P. Cullen, M.D. . Surgeon-Major G. R. Daithary, M.D. .	8th Dec. "	31st Mar. 1884	Bihari Lal Parasar . . .	7th Mar. 1884	12th Mar. "	
Seoni . . .	Ditto	Surgeon-Major P. Cullen M.D. . Surgeon-Major J. B. Gaffney . . . Surgeon H. Armstrong . . . Appointment of Superintendent was vacant . . .	1st April "	31st Mar. 1884	Punchum . . .	13th Mar. 1883	31st Mar. "	
Chanda . . .	Ditto	Assistant Surgeon Haran Chunder Dutt . . . Assistant Surgeon Shih Chunder Bhatlacharji . . . Assistant Surgeon Haran Chunder Dutt . . . Tehsildar Horahar Govind . . .	13th April "	30th April "	Seetaram . . .	1st April "	31st Mar. "	
Sironcha . . .	Ditto	Brigade-Surgeon D. W. Trinnell . . Surgeon-Major J. F. Barter . . . Brigade-Surgeon D. W. Trinnell . .	1st May "	31st Aug. "	Hospital Assistant Muthu Krishna Naidu . . .	1st April "	31st Mar. "	
Raipur . . .	Ditto	Brigade-Surgeon D. W. Trinnell . . Surgeon-Major J. F. Barter . . . Brigade-Surgeon D. W. Trinnell . .	1st Sept. "	31st Mar. 1884	Krishna Rao . . .	1st April "	31st Mar. "	
Sambalpur . .	Ditto	Honorary Surgeon-Major J. E. Harrison . . .	1st April "	31st Mar. "	Babu Sham Sunder Dass . . . <i>Additional Observer.</i> Hospital Assistant Syed Mahamad Hyder Hussain Hydari . . .	1st April "	31st Mar. "	

APPENDIX E.

List showing the Names of the Superintendents and Observers at the Meteorological Observatories reporting immediately to the Office of the Meteorological Reporter to the Government of India during the year 1883-84.

Observatories.	Class.	Names of Superintendents.	PERIOD.		Names of Observers.	PERIOD.	
			From	To		From	To
ADEN	Third	{ Captain C. W. H. Sealy Major F. M. Hunter Captain C. W. H. Sealy Captain J. S. King	{ 1st April 1883 30th Nov. 1883 1st Feb. 1884 21st Feb. "	{ 20th Nov. 1883 31st Jan. 1884 20th Feb. " 31st Mar. "	{ D. C. Cotingho, Observer A. S. Vas, Shaik Ebrahim, Walter Abraham, Shaik Ebrahim, Asst. Observer A. S. Vas, B. C. Cordeiro, "	{ 1st April 1883 30th Aug. " 19th Sept. " 16th Mar. 1884 1st April 1883 19th Sept. " 1st Jan. 1884 1st April 1883 1st April "	{ 20th Aug. 1883. 15th Sept. 1884. 31st Mar. " 18th Sept. 1883. 31st Dec. 1884. 31st Mar. " 31st Mar. " 31st Mar. " 21st July 1883. 12th Feb. 1884. 31st Mar. "
BUSHIRE	Ditto	Lieutenant-Colonel E. C. Ross, C.S.I.	1st April 1883	31st Mar. "	Mr. Azavedo	1st April 1883	31st Mar. "
QUETTA	Ditto	J. C. Fullerton, M.B.	1st April "	31st Mar. "	A. Samuel Pillay	1st April "	31st Mar. "
PACHUDRA	Ditto	Mr. G. A. Bradford	1st April "	31st Mar. "	Mr. P. Holder Khudabux Rash Behari Ghosh.	1st April 22nd July 13th Feb. 1884	31st Mar. " 12th Feb. 1884. 31st Mar. "
MUSOOREE	Ditto	Revd. Father Lawrence " Benedict	1st April 1st Feb. "	31st Jan. 31st Mar. "	J. Flynn J. Archibald	1st April 1883 16th Jan. 1884	15th Jan. " 31st Mar. "
KATMANDU	Ditto	.....	.....	.....	Mohamad Hassain Pashupat Sharan Sinha Mohamad Hassain Pashupat Sharan Sinha	1st April 1883 14th Aug. 1883 21st Oct. " 29th Dec. "	15th Jan. " 31st Mar. " 20th Oct. " 31st Mar. 1884.
MONGPOO	Fourth.	.....	.....	.....	George A. Gammie	1st April "	31st Mar. "
MAKHLA	Ditto	{ J. Balantine, Esq. A. T. Drysdale, Esq. J. Ballantine, Esq.	{ 1st April 1883 28th Aug. " 28th Nov. "	{ 27th Aug. 1883 27th Nov. " 31st Mar. 1884	Kuarsing Narain Yadeo Kuarsing Papannah	1st April " 1st Sept. " 23rd Sept. " 20th Jan. 1884	31st Aug. 1883. 18th Sept. " 19th Jan. 1884. 31st Mar. "
DIAMOND ISLAND	Third	.....	.....	.....	F. W. Marsh	1st April 1883	31st Mar. "
PORT BLAIR	Ditto	Surgeon-Major J. Reid, M.B.	1st April 1883	31st Mar. 1884	J. T. Peters	1st April "	31st Mar. "
NANCOWRY	Ditto	.....	.....	.....	Shaik Abdood Wahed Shaik Madar Roop Sing Rana	1st April " 13th July " 25th Feb. 1884	18th July 1883. 24th Feb. 1884. 31st Mar. "
KAILANG	Ditto	Revd. A. W. Heyde	1st April 1883	31st Mar. 1884	Tsang Rinchen	1st April 1883	31st Mar. "

APPENDIX F.

Extracts from the Report on the Administration of the Meteorological Department in Western India during the year 1883-84.

During the past official year observations have been taken in Western India at 4 second class, 18 third class and 1 storm-warning station. No changes have been made in the nature of the observations; but it has been decided to institute a change in some of the observerships that will probably prove an important one. The same inconvenience which in last year's report it was stated had led to the substitution of civilian, in place of military, observers at the second class stations, has been felt in an equal degree in the case of those third class observatories at which military medical subordinates are observers. It has been determined, therefore, that, wherever practicable, these observers shall be replaced by independent men with whom the meteorological shall be the primary work.

OBSERVATORIES.

The number of observatories, as shown by the list given in Appendix F II, remains the same as in last year. Sanction of the Government of India to the establishment of a voluntary observatory at Baroda was received through the Government of Bombay in September 1883, and accordingly instruments were forwarded to Baroda in November 1883. Mr. Joglekar, the headmaster of the Sirdar High School, who volunteered to establish the observatory, succeeded in getting an anemometer tower built over the porch of the school, and had chosen a site for the thermometer shed, when the school building was required for other purposes. The school had to be removed into temporary quarters, and the anemometer tower had to be pulled down. Mr. Joglekar hopes before long to be able to make other and more permanent arrangements.

For reasons given below under the heading of Inspection of observatories, the project for the establishment of an observatory at the new site at Sholapur has now been definitely abandoned, and after some difficulty arrangements have been made for the continuance of the observatory at the old site.

On the 10th of October last, a letter was received from the Surgeon General with the Government of Bombay, stating that the Agency at Zanzibar was on the 1st of September transferred from the Government of Bombay to the English Foreign Office, and requesting that early arrangements might be made for relieving the Hospital Assistant there of his meteorological duties, as he was to be removed from Zanzibar immediately. This was the first intimation the Meteorological Office had of any intended changes at Zanzibar; had earlier information been received earlier arrangements might have been made for the continuance of the observatory there. As it was, the Surgeon General was pleased to agree to, and the Government of Bombay to sanction, the temporary retention as observer of the Hospital Assistant Abdur Rahman until the English Foreign Office could be moved in the matter. Up to the present date nothing has been communicated as to the intentions of the Foreign Office. Surgeon M. L. Bartholomeux, who had been the Agency Surgeon at Zanzibar, gave me, on his return to Bombay, a verbal description of the observatory there. This description agreed in all essential details with that given by Dr. Peters in his paper published in the Royal Meteorological Society's Journal for October 1883; therefore it is not necessary to reproduce it here.

INSPECTION OF OBSERVATORIES.

In October and December 1883; and in March and April 1884, I visited seventeen stations, namely Bhuj, Karachi, Hyderabad (Sind), Jacobabad, Poona, Sholapur, Ratnagiri, Karwar, Calicut, Belgaum, Surat, Baroda, Deesa, Mount Abu, Neemuch, Indore, and Malegaon. Sholapur was visited twice; and with the concurrence of Miss Pogson, Meteorological Reporter to the Government of

Madras, I called, on the way to Calicut, to see the observatory at Mangalore, which is one of the stations forwarding daily weather telegrams to the Bombay Office.

* * * * *

SECOND CLASS OBSERVATORIES.

(1) *Karachi*.—The instruments here were in good condition and call for no special remark. A new site for the observatory had been chosen near to the anemometer tower; the position was better than the present one. Estimates amounting to Rs. 1,333 have been prepared for the buildings, &c., but, as it has not yet been decided to extend the hospital buildings, I have thought it advisable for the present to allow the matter to remain in abeyance.

(2) *Deesa*.—The instruments here were all in good order, except that the recording apparatus of the anemograph required cleaning, and the arrangement for disconnecting the clock and the cylinder were out of order. These matters I attended to. The trap door and the ladder of the anemograph tower were awkwardly constructed, and it was exceedingly difficult and even dangerous to use them. They are now about to be altered. The upper parts of the dry and wet bulb thermometers were screened by the frame-work of the cage door; so that, in order to read the higher degrees it was necessary to open the door. The observer pointed out that immediately after doing so the temperature within the cage went up about $\frac{1}{3}$ degree. I recommended him always to open the door before reading the thermometers.

The observer had great difficulty in getting an assistant. Deesa is nothing but a military camp, and is very backward in point of education.

(3) *Poona*.—The instruments here were in order, except that the grass thermometer pad had no stuffing. The observer had taken observations by Presidency local time instead of Poona local time; there is a difference of about 5 minutes. The Casella's anemograph had worked since last year with as satisfactory results as can be obtained from this class of instrument.

(4) *Belgaum*.—Everything on the whole was satisfactory at this observatory. The mercury in the barometer moved sluggishly, but the observer stated that he was in the habit of tapping it before reading. The observer, Ram Chandra Datta, had been trained by his predecessor; I examined him thoroughly, and found that he had taken pains to prepare himself for the examination. I instructed him in those matters in which he was deficient; cloud observation was his weak point, as indeed it is with many observers. I examined the assistant observer also.

Estimates for observatory buildings to be situated near the anemograph tower have been prepared amounting to Rs. 2,764; they have not yet been forwarded to Government for sanction.

THIRD CLASS OBSERVATORIES.

(5) *Jacobabad*.—The anemometer and the barometer were in good order. The graduation marks of the thermometers required re-blackening. The grass thermometer had been exposed under the stand of the sun thermometer by Narayen Mane, who had not understood that the sun thermometer stand, which is a moveable one, should have been taken away every night. The rain gauge was placed on some bricks, and was in consequence about 3 inches too high. I had it properly fixed in the ground. Narayen Mane had been very ill for some time and quite unable to give proper attention to work of any kind. He was, at my suggestion, replaced in September by Bavaji Rawoot, whose work has given satisfaction.

(6) *Hyderabad (Sind)*.—The instruments at the military hospital were all in good order; and the observer, V. E. Nazareth, who had trained himself in meteorological work by means of the instruction book, showed himself both careful and intelligent.

The same cannot be said for the observer who has charge of the anemometer at the jail. His work is so unsatisfactory in every way that his relief from meteorological duties only awaits the making of other arrangements for continuing the observations.

(7) *Bhuj*.—The surface of mercury in the cistern had been coated with a thin layer of rust, and three small particles of dirt had formed on the knife edge. The observer adjusted the mercury until it just touched these three particles; I approved of this method of adjustment, but the effect of it was,

of course, to lower the readings, the additional correction required was +.016. The barometer should be locked in a case or screen fixed to the wall; some of the hospital inmates came to finger it even in my presence. The thermometer shed was a little larger than the standard pattern, and the ventilating opening was too large. The thermometer graduation marks required re-blackening. The rain-gauge had, shortly before my arrival, been tarred all over, including the rim, so that the size of the rim was altered; but this I instructed should be cleaned off at once, and, as no rain had fallen in the meantime, the matter was of no consequence. The instruments in all other respects were in order. The anemometer post however was difficult to ascend; and in carrying the instrument up and down for cleaning, damage was likely to be done to the cups.

(8) *Surat*.—The instruments at the camp were found in order. Owing to the destructiveness of jackals, no grass thermometer has been supplied to this station since June 1883. An arrangement had been made by the observer for the protection of the grass thermometer, but it would have interfered with free radiation, and was therefore unsuitable. The wind direction observations of the observer, Dhunjibhai Motabhai had evidently been very roughly taken; and his punctuality was considered doubtful. He has since been ordered away to Quetta.

The observer who had charge of the anemometer at the castle was a new man, who had been instructed by his predecessor. He was intelligent, and easily understood what I taught him. The anemometer was out of order, the pointer being loose, and the spindle bearing the cups having become broken at the junction of the brass with the steel. I put the instrument in order and also instructed the observer in cleaning it.

Surgeon-Major Robb, M.D., F. R. Met. Soc. the Civil Surgeon, who, in accordance with his own wish, had charge of both the observatories, took great interest in the work, and, besides cordially assisting in the superintendence of the observatories, has forwarded to the meteorological office some special observations of his own.

(9) *Mount Abu*.—I found that, as previously surmised, the barometer No. 48-1868 by Adie had air in it; it was packed up and returned to Bombay. The old barometer No. 710-1868 was all right, except that the cistern was dirty inside. I showed the observer how by regulating the lights and shadows he could take very accurate readings with it. All the readings of the new barometer had better be rejected, and those of the old, which have been taken continuously side by side with the others, used in their place. The wet bulb thermometers had an incrustation of some thickness. The other instruments were in good order. The observer, Bapalal Metha, was trained by his predecessor, Corporal C. Barley, a year and a half ago. I pointed out to him all those parts of the instruction book which refer to third class observatories.

(10) *Neemuch*.—The barometer cistern was dirty inside, but it was quite possible to take correct readings. The fence round the radiation thermometers and rain-gauge was, I thought, too high; and the rain-gauge was protected by the sun thermometer stand. The wet bulbs of the thermometers were covered with sediment, but perhaps not more than was to be expected at Neemuch at that time of the year. The observer had covered them with lint instead of with muslin. The pointer of the anemometer was loose. The observer, T. Bachu, is a painstaking man, but he is very slow of understanding, and is scarcely able to discover for himself any irregularities that may occur in the instruments. He has recently become an attested military man, and is now liable to be removed for active service at any time.

(11) *Indore*.—The instruments were in good order, excepting that some of the thermometers required the graduation marks re-blackening. The anemometer was taken down and cleaned. The necessity for a tower for it is very great, as mentioned in last year's report, and I promised to make a sketch of what was required. The observer, Trimvakrao, who was trained by his predecessor, is an intelligent man, but for some reason or other his observations on two or three occasions have required very careful checking. I marked out for him those parts of the instruction book to which his attention was necessary, and tried to impress him with the importance of carefulness in his work.

(12) *Malegaon*.—Solomon Aaron, who succeeded Gopal Cuddum, had left Malegaon a few days before my arrival there. His work was very defective. He was succeeded by an observer who had been trained at Poona, and who appeared likely to do the work satisfactorily. I examined him carefully and instructed him where he needed it. The barometer No. 27-1868, by Adie, had for some time been suspected to be out of order, as the readings at Malegaon for the past three or four years had been abnormally high when compared with the surrounding stations. But its vacuum was very good, and I could find nothing wrong with it except that the cistern was dirty, and that it was placed in a bad light. Dr. Carson had a new and well-lighted place provided for it, and by the proper regulation of the lights and shadows it was possible to read it in its new position quite accurately. I had taken with me a new barometer to be left in place of the old one, but on unpacking it air was found in the upper end of the tube, and it had to be returned to Bombay. I took to pieces and cleaned the anemometer (one of the five wheel ones); it had been very badly put together by some one, so that it not only worked stiffly, but the worm and worm wheel had become very much worn.

(13) *Ratnagiri*.—Everything was in good order here. The anemograph tower, however, requires additional protection from the rain, which during the monsoon makes its way through the laterite stone of which the tower is built, and causes the recording room to be very damp.

(14) *Sholapur*.—Application was made in the month of July last for sanction to be granted to the transfer of the observatory at this station from the old site to the telegraph office; but it was requested that before sanction was granted enquiries should be made as to the permanency of the telegraph office in its present quarters. Sanction was granted. The Telegraph Master was sent to Bombay for training, estimates for the necessary buildings were prepared and sanctioned by the Bombay Government, a set of instruments was forwarded to the telegraph office, the Telegraph Master began to take barometer and general weather observations, and he trained a man to take the observations for a year at the old site; but when the Public Works Officer came to the point of putting up the anemometer tower and other observatory erections, it was found that the permanency of the telegraph office in its present quarters was quite uncertain. This discovery upset all the arrangements; and it is only after much difficulty that the matter has been satisfactorily settled. A young man has been found willing to serve as observer at the old site on the pay of Rs. 15 with the prospect of good work allowances; he engages to live near to the observatory, and to remain there for some years. The observatory, therefore, will continue at the old site.

The man trained by the Telegraph Master, was, I found, unable to read the barometer correctly, and his readings from November 1st to December 20th have had to be rejected, and those of the Telegraph Master used in their place. The instruments were all in good order, except the wind vane, which had to be sent to Bombay for repair.

The height of the barometer cistern at the new site was 1566-70 feet above the sea-level.

(15) *Karwar*.—The instruments here were in good condition. Trees grew too close to the raingauge enclosure, and I recommended they should be cut down. The site is not good for wind observations owing to the surrounding hills, and for this reason the anemometer had never been erected, but Mr. Westbrook, the Port Officer and Superintendent of the observatory, said he would have it placed near the light-house, in the position which had once been occupied by an anemograph erected in connection with the tidal operations; wind observations will therefore be taken by the light-house keeper. The observer here, G. W. M. D'Aranjo, is a careful and intelligent man, and his observations are always trustworthy.

(16) *Calicut*.—This observatory was established by the Bombay Office in connection with the Bombay Storm Warning System, and is not a regular observatory; it has, however, all instruments except radiation thermometers, and the observer gets the usual monthly allowance. The thermometers I found were hung in the Port Officer's Office, a small second floor room with windows in the north, west, and south walls; the hygrometer was hung on the south wall, and the maximum, and minimum thermometers on the east. The raingauge was on the north-east side of the Custom House,

and I thought somewhat protected from the principal rain-bearing winds. It was fixed in a wooden frame-work, constructed after a local pattern. The anemometer was situated at the pier head in very good position; but it was fixed directly on to the ridge of a roof, contrary to express instructions, and was below the level of some neighbouring cranes. The entire re-arrangement of this observatory is under consideration; but there is difficulty in finding a suitable site.

* * * * *

WORK OF THE SECOND CLASS OBSERVERS.

The work of the observers appointed to Deesa and to Poona has given satisfaction, and that of the Karachi observer was on the whole good, except that I had reason to believe he left a great part of the observational work to his assistant. Keshav Vishnu at Belgaum soon gave evidence that he cared very little for meteorological work, and would be glad to get rid of it; after holding his appointment for only three months he applied to resign; his application was refused, but he applied again and again, and finally, after he had trained his assistant to do both the observational and the computing work, he sent word that he intended to leave the department, and would draw no more pay, though, if I would not grant his application, he would be obliged to attend the office up to the end of the time I had fixed. After some precautions had been taken for the proper carrying out of his work by the assistant, he was allowed to resign; his work was not of a very high character, and his successor, it will be seen from the list of merit, has given greater satisfaction. In January 1884 the Karachi observer applied to resign; arrangements were made for training his assistant, who has since relieved him.

APPOINTMENT OF INDEPENDENT OBSERVERS TO THIRD CLASS STATIONS.

Great inconvenience has frequently been felt by the Meteorological Department in Western India in connection with those third class observatories at which the observers have been military medical subordinates. These observers have always been liable to frequent transfer in connection with their primary duties. It was seldom that notice of intended transfers reached the Meteorological Office, and it not unfrequently happened that men were appointed to these posts who were indifferently qualified for the work. In this way much extra correspondence has been entailed, and what is more serious, the character of the registers has sometimes suffered. I was induced, therefore, in January last to make certain proposals to the Surgeon General, Her Majesty's Forces, Bombay, with a view to preventing the breaks in the registers which resulted from these transfers, and to securing the appointment of only qualified observers. The ultimate result has been a decision to replace the military medical subordinates by independent men on the usual meteorological allowances whose primary work shall be the meteorological. This arrangement, if it be found workable, will be very satisfactory to the Meteorological Department, for not only will the character of the registers be improved, and (providing arrangements be made for relieving the observers during sickness) the interruptions be less frequent, but a great saving will be made in the work of the Bombay Office, as there will be less correspondence and less training of observers.

ALTERATIONS IN THE FACTORS OF INSTRUMENTS.

During my tours of inspection I compared the barometers and thermometers of all the observatories with the travelling standards; the results are given below—

STATIONS.	Barometer.	Dry bulb thermometer.	Wet bulb thermometer.	Dry maximum thermometer.	Dry minimum thermometer.	Wet minimum thermometer.	Gross radiation thermometer.
	Inch.	°	°	°	°	°	°
Kurrachee . . .	Fallen 0.11	Risen 0.3	Risen 0.2	Fallen 0.3	Fallen 0.1	Risen 0.1	.....
Deesa	„ 0.08	„ 0.3	Fallen 0.3	Risen 0.4	0.0	Fallen 0.4	.....
Poona	„ 0.05	„ 0.1	„ 0.0	„ 0.1	Fallen 0.1	„ 0.5	.....

STATIONS.	Barometer.	Dry bulb thermometer.	Wet bulb thermometer.	Dry maximum thermometer.	Dry minimum thermometer.	Wet minimum thermometer.	Grass radiation thermometer.
	Inch.	°	°	°	°	°	°
Belgaum . . .	Fallen '009	Risen 0'1	Risen 0'1	Risen 0'3	Fallen 0'1	Risen 0'1	Risen 0'4
Jacobabad . . .	'000	„ 0'2	Fallen 0'2	.....	Risen 0'1	Fallen 1'3	0'0
Hyderabad . . .	Risen '004	Fallen 0'1	Risen 0'2	Risen 0'2	„ 0'1	0'0	.....
Bhuj . . .	Fallen '016	Risen 0'2	0'0	„ 0'2	„ 0'4	Fallen 0'3	Risen 0'1
Surat . . .	Risen '001	0'0	Risen 0'2	„ 0'2	„ 0'1	„ 0'4	.....
Mount Abu . . .	Fallen '003	Risen 0'1	Fallen 0'5(?)	0'0	0'0	„ 0'1	Fallen 0'1
Neemuch . . .	Risen '002	„ 0'2	Risen 0'2	0'0	0'0	„ 0'1	Risen 0'1
Indore . . .	Fallen '005	0'0	„ 0'1	Risen 0'3	Fallen 0'2	„ 0'5	.....
Malegaon . . .	Risen '008	Risen 0'3	Fallen 0'2	„ 0'1	0'0	0'0	.....
Ratnagiri . . .	Fallen '003	„ 0'4	Risen 0'5	0'0	0'0	Fallen 0'3	0'0
Sholapur . . .	Risen '002	„ 0'1	„ 0'2	0'0	Risen 0'2	„ 0'7	Risen 0'1
Karwar . . .	'000	„ 0'5	0'0	Risen 0'3	Fallen 0'1	„ 0'4	„ 0'1
Calicut . . .	Fallen '004	„ 0'1	Fallen 0'1	„ 0'2	.....	.....	.....

In the table of alterations of factors given in the Administration Report of 1882-83, the words "Fallen" and "Risen" were interchanged throughout, and some other errors of computation were made. The following is the revised and corrected table for that year:—

Alterations of Factors of Instruments in 1882-83.

STATIONS.	Barometer.	Dry bulb thermometer.	Wet bulb thermometer.	Dry maximum thermometer.	Dry minimum thermometer.	Wet minimum thermometer.	Grass radiation thermometer.
	Inch.	°	°	°	°	°	°
Karachi . . .	Fallen '011	Risen 0'3	Risen 0'2	Risen 0'1	Fallen 0'2	Fallen 0'1	Risen 0'2
Deesa . . .	„ '005	„ 0'2	Fallen 0'2	„ 0'5	„ 0'1	?	.....
Poona . . .	.....	„ 0'2	Risen 0'1	„ 0'1	„ 0'1	Fallen 0'5	.....
Belgaum . . .	Fallen '012	„ 0'2	„ 0'2	„ 0'4	0'0	.....	Risen 0'4
Jacobabad . . .	„ '002	„ 0'1	Fallen 0'2	.....	Risen 0'1	Fallen 0'8	„ 0'1
Hyderabad . . .	Risen '006	.....	.....	Risen 0'1	„ 0'4	Risen 0'1	0'0
Surat . . .	„ '001	.....	Risen 0'3	„ 0'1	0'0	0'0	Fallen 0'3
Mount Abu . . .	No. 48 Fallen '083	0'0	„ 0'1	„ 0'1	Risen 0'1	0'0	0'0
Mount Abu . . .	No. 710 Fallen '005	.....	.....	.....	.....	.....	.....
Neemuch . . .	„ '004	Risen 0'1	Risen 0'1	Risen 0'1	.....	Fallen 0'3	.....
Indore . . .	„ '006	„ 0'1	0'0	„ 0'4	Risen 0'1	„ 0'3	.....
Malegaon . . .	Risen '014	„ 0'1	0'0	0'0	„ 0'1	0'0	.....
Ratnagiri . . .	Fallen '004	„ 0'2	Risen 0'5	Risen 0'1	Fallen 0'2	Fallen 0'5	?
Rajkot . . .	„ '008	„ 0'1	0'0	„ 0'3	Risen 0'1	„ 0'8	Risen 0'5
Amraoti . . .	.....	.....	.....	.....	Fallen 0'3	Risen 0'1	Fallen 0'4

THE LIBRARY.

One hundred and eleven books were added to the library during the past year, making a total of 824. They have all been compared with the catalogue and found correct.

WORK OF THE BOMBAY OFFICE.

The work of the office has consisted of the usual receipt, correction, computation, and tabulation of the observations from the third class observatories, and the correction and tabulation of those from the second class observatories; the checking of these observations by means of actual and abnormal curves, and the examination of every discovered instance of erroneous or doubtful observation; the training and in some cases appointment of observers; the comparison and issue of instruments; the conducting of the storm-warning service; the receipt, arrangement, and in some cases translation from the vernaculars (but not the control) of rainfall returns from over 400 stations; the forwarding of the complete monthly returns to the Meteorological Reporter to the Government of India, and of the monthly abstracts published in the *Bombay Government Gazette*; the furnishing of special information to the public and to Government departments; the conducting of special investigations and research; the management of the finances of the department; and the conducting of the correspondence involved by all the above-mentioned works.

TRAINING OF OBSERVERS.

The following is the list of observers trained in the Bombay Office during the year 1883-84:—

Second Class	{	Narayan Vinayek Raje finished his training on 19th April 1883 and was sent to Karachi.
	{	Minquel Fernandez was in training on the 31st March 1884, and was to be sent to Karachi.
	{	Passed Native Medical Pupil Solomon Ezekiel obtained his certificate on the 9th July 1883.
Third Class	{	Telegraph Master R. P. Stephens, trained on 13th July 1883, and employed at Sholapur (new site).
	{	2nd Class Hospital Assistant Babaji Rawoot obtained his certificate on the 31st July 1883 and was subsequently employed at Jacobabad.

In addition to the above the following were trained locally:—

Second Class	{	Ramchandra Datto trained at Belgaum by his predecessor in September 1883 and by the Acting Meteorological Reporter in March 1884, and was employed as observer on 12th September 1883.
Third Class	{	Goolzar Sing trained by Telegraph Master R. P. Stephens at Sholapur, and employed at the old site on 1st November 1883.
	{	Shunker Rao trained by his predecessor and employed at Buldana on 1st June 1883.

* * * * *

The suggested arrangements referred to in last year's report, for the better exposure of the instruments at Goa, were submitted by Mr. Martins to the Goanese Government and sanctioned; and a request was made to the Meteorological Office by the Portuguese Consul in Bombay for assistance in obtaining the necessary thermometer cage, solar thermometer stand, and a grass thermometer pad. With the sanction of the Government of Bombay these articles were sold to the Consul from the stock in hand.

STORM-WARNING SERVICE.

No alteration in this service has been made during the past official year. Telegrams of the daily 10 hours observations have been received regularly from the following stations:—

Karachi.	Calicut.
Surat.	Cochin.
Ratnagiri.	Negapatam.
Karwar.	Madras.
Mangalore.	Masulipatam.

These, after reduction, have been, together with the observations from Bombay, curved and charted; and a written report of them has been daily posted up in the Port Office; also one copy of

the report has been forwarded to the *Times of India*, and an abstract of it to the *Bombay Gazette*. Besides these regular telegrams, special ones, have been called for on special occasions.

Telegrams of a cautionary or re-assuring nature, or instructing that the storm-signals should be hoisted, have been issued as follows:—

Names of Ports,	Dates on which the telegrams were sent to hoist storm-signals,	Dates on which Cautionary telegrams were sent,	Date on which Re-assuring telegrams were sent.
Karachi . . .	3rd July 1883	24th and 29th April, 22nd May, 3rd and 29th June, 2nd July, 19th October, and 11th November 1883.	4th July 1883.
Bhavnagar . . .	3rd July „	24th April, 22nd May, 2nd July, 19th October, and 11th November 1883.	.....
Daman . . .	3rd July „	24th April, 22nd May, 2nd July, 19th October, and 11th November 1883.	.....
Bombay . . .	.....	25th June 1883.	.....
Goa . . .	.....	2nd May and 5th October 1883.	.....
Vingorla . . .	.....	2nd May 1883.	.....
Kárwár . . .	.....	2nd May and 5th October 1883.	.....
Kumta . . .	.....	2nd May 1883.	.....

As will be seen from the above list, the only storm of sufficient violence to make it necessary to hoist the storm-signals was that which crossed the peninsula at the end of June and beginning of July.

During my absence on tour, Mr. F. Chambers, the Acting Superintendent of the Government Observatory, Colaba, examined the daily weather charts and reports, and advised the office as to the calling in of special telegrams and the issue of storm-warnings.

The telephone which was fixed in the meteorological office in the month of August 1882, and is connected with the Bombay Central Telegraph Office, has, with the exception of two or three occasions, worked satisfactorily.

SPECIAL WORK.

A brief sketch of the meteorology of the Bombay Presidency in 1882-83 was prepared in September last for the Bombay Government. During the writing of this sketch I made some discoveries of quantitative relations which had existed between previous and subsequent barometric movements in Western India during the years 1870 to 1883. I followed up these discoveries in a paper entitled "Some Results of an Examination of the Barometric Variations in Western India," which was submitted to the Royal Meteorological Society in February last, and has since been read at one of their meetings. The paper written by me last year on the "Transmission Eastwards round the Globe of Barometric Abnormal Variations" was published in *Nature* of August the 9th and 16th, 1883. I have worked out in detail and made complete drawings of the design for a component anemograph, of which mention was made in last year's report. I have also invented an entirely new form of vane, the object of which is to work with scarcely any friction, and yet without oscillation. I have also introduced some improvements into the design for the support of the anemograph cups. Drawings of the cups and vane, together with those of the resolving and recording apparatus, have been submitted with a descriptive paper to the Royal Meteorological Society. I have also been

engaged in an investigation of the barometric abnormals of Malegaon, and have obtained results which seem to throw light on the question of reduction to sea-level of barometric values at plateau stations. I have not yet been able to work up these results in the form of a paper.

Out-of-office hours I have made some comparisons between the meteorological and the health statistics of Bombay ; but the fact pointed out in one of the recent reports of the Health Officer that the Health Statistics of Bombay are influenced in a very important degree by emigration, and that, until recent years, this fact had not been taken into consideration in compiling the Health Statistics, led me to desist for the time being from further labour on the subject.

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OFFICE ESTABLISHMENT.

I remained acting as Meteorological Reporter for Western India up to the 6th June 1883, on which date, Mr. F. Chambers, the permanent incumbent, returned to duty. He held charge of the office up to the 18th June, when he was appointed to act as Superintendent of the Government Observatory, Colaba, and I, having been appointed by the Government of India to "continue" acting as Meteorological Reporter, resumed charge of the Meteorological Office. My appointment was subsequently sanctioned by the Secretary of State for India.

The other members of the office staff at the end of the year were as follows :—

Name.	Monthly Pay.
FOR LAND METEOROLOGY.	
Rs.	
Ganesh Sadashiv	57
Vajeram Jeeharam	42
Mahadev Ramchandra	40
Krishnaji Ramchandra	30
Ramchandra Sadashiv	30
FOR STORM-WARNING SERVICE.	
Ramchandra Govind	30
Anant Vishvamber	30

There is one menial on Rs. 10 per month ; and a peon on Rs. 10 per month was sanctioned by the Government of India and engaged on the 11th August 1883.

I have during the year forwarded to Mr. Blanford a detailed statement of the work done by the office, and have asked his favourable consideration to certain proposals for an increase, both in the number of clerks and in the scale of pay of the present staff. It is difficult to see how the work of the office can be reduced to any useful extent without prejudicing the character of the meteorological returns. Great attention has always been paid to checking the observations ; indeed this is, next to the computation, the most time-absorbing work in the office.

I have had every reason to be satisfied with the work of the clerks ; they have all worked intelligently, and with care and diligence.

In conclusion, the thanks of the department are due to the various medical officers in charge of the observatories, many of whom have rendered valuable assistance.

A. N. PEARSON,

Acting Meteorological Reporter for Western India.

METEOROLOGICAL OFFICE, BOMBAY,

The 24th June 1884.

APPENDIX F II.

Names of the Superintendents and of the Observers who have officiated at the Observatories in Western India during the year 1883-84.

STATION.	Class.	Superintendent.	PERIOD.		Observer.	DATE.		REMARKS.
			From	To		From	To	
Karachi . . .	Second .	Surgeon-Major J. Paxton .	1st April 1883	26th Mar. 1884	Private F. Bateman . . .	1st April 1883	27th April 1883	
		Surgeon D. O. Sullivan . .	27th Mar. 1884	31st Mar. "	Narayan Vinayek Rajee . .	28th April "	31st Mar. 1884	
Deesa . . .	Ditto .	Surgeon-Major F. Lyons . .	1st April 1883	9th July 1883	Ramkrishna Keshav Karandiker .	1st April "	31st Mar. "	
		Surgeon G. J. Ward . . .	10th July "	8th Oct. "				
		Surgeon-Major F. Lyons . .	9th Oct. "	31st Oct. "				
		Surgeon G. J. Ward . . .	1st Nov. "	28th Nov. "				
		Surgeon-Major F. Lyons . .	29th Nov. "	14th Feb. 1884				
		Surgeon C. B. Matland . . .	15th Feb. 1884	23rd Feb. "				
		Surgeon-Major F. Lyons . .	24th Feb. "	31st Mar. "				
Yerowda (Poona) .	Ditto .	Ditto S. M. Salomon . . .	1st April 1883	31st Mar. "	Narayan Sakharan Kelkar . .	1st April "	31st Mar. "	
Belgaum . . .	Ditto .	Ditto R. P. Ferguson . . .	1st April "	31st Mar. "	Keshav Vishnu Apte . . .	1st April "	11th Sep. 1883	
					Ramchandra Datta . . .	12th Sep. "	31st Mar. 1884	
Jacobabad . . .	Third .	Surgeon J. McCloghry . . .	1st April "	9th April 1883	Naryen Mane . . .	1st April "	13th Sep. 1883	
		Ditto B. N. Koyaji . . .	10th April "	18th April "	No Observer . . .	14th Sep. "	16th Sep. "	
		Ditto K. H. Mistri . . .	19th April "	2nd June "	Babajee Rawoot . . .	17th Sep. "	31st Mar. 1884	
		Ditto B. N. Koyaji . . .	3rd June "	31st Mar. 1884				
Bickaneer . . .	Ditto .	No Superintendent . . .	.....	....	Ram Lall . . .	1st April "	31st Mar. "	
Hyderabad (Sind) .	Ditto .	Surgeon-Major H. M. Macbeth .	1st April 1883	31st Mar. 1884	V. E. Nazareth . . .	1st April "	31st Mar. "	
Bhuj . . .	Ditto .	Surgeon W. A. Barren . . .	1st April "	31st Mar. "	Mahesh Bux Sing . . .	1st April "	31st Mar. "	
Mount Abu . . .	Ditto .	Surgeon-Major Charles White .	1st April "	29th Oct. 1883	Bapalal Mehta . . .	1st April "	31st Mar. "	
		Ditto H. T. Chapman . . .	30th Oct. "	28th Dec. "				
		Ditto Charles White . . .	29th Dec. "	31st Mar. 1884				
Neemuch . . .	Ditto .	Ditto J. R. Croker . . .	1st April "	30th April 1883	T. Bachu . . .	1st April "	31st Mar. "	

Indore	Surgeon S. J. Flood.	1st May	31st May	Trimbakrao	1st April	31st Mar.
Rajkote	Surgeon-Major J. R. Croker	1st June	31st Mar. 1884	Solomon Samuel	1st April	16th Jan.
	Ditto D. F. Keegan	1st April	31st Mar.	Keshav Govind	17th Jan. 1884	31st Mar.
	Ditto S. B. Haliday	1st April	20th Mar.	Dhunjibhai Motabhai	1st April 1883	31st Mar.
Surat	Surgeon S. T. Avetoon	21st Mar. 1884	31st Mar.	Samuel Gregory	1st April	31st Mar.
	Surgeon-Major J. Robb	1st April 1883	31st Mar.	Mahomed Samsudin.	1st April	1st April 1883
Akola	Surgeon J. J. Moran	1st April	31st Mar.	Bukaram Pandrang.	2nd April	31st Mar. 1884
Amraoti	Ditto T. Hume	1st April	31st Oct. 1883	Hiralal	1st April	31st Mar.
	Apothecary W. E. Hendricks	1st Nov.	30th Nov.	Pandurang Krishnaji	1st April	31st May 1883
Chikalda.	Surgeon T. Hume	1st Dec.	31st Mar. 1884	Shunker Ramrao	1st June	31st Mar. 1884
	Ditto C. L. Swaine	1st April	2nd Jan.	Gopal Cuddum	1st April	11th Dec. 1883
Buldana.	Ditto R. James	3rd Jan. 1884	31st Mar.	Solomon Aaron	12th Dec.	31st Mar. 1884
	Apothecary D. Callaghan.	1st April 1883	31st Mar.	Atmaram Bapuji	1st April	31st Oct. 1883
Malegaon	Surgeon P. J. Damania	1st April	11th Dec. 1883	Gulgarsing Luxman Sing.	1st Nov.	31st Mar. 1884
	No Superintendent	12th Dec.	5th Feb. 1884	Mahadev Cuddum	1st April	31st Mar.
Sholapur	Surgeon M. Collie	6th Feb. 1884	19th Feb.	Surgeon M. L. Bartholomeuz	1st April	20th April 1883
	Ditto W. P. Carson	20th Feb.	31st Mar.	Abdur Rehman	21st April	31st Mar. 1884
	W. R. Scroggie, Esq., L.R.C.P.	1st April 1883	31st Mar.	G. W. M. D'Aranjo.	1st April	31st Mar.
Ratnagiri	Surgeon H. McCalman	1st April	25th Sep. 1883	F. D'Rozario	1st April	31st Mar.
	Ditto Arthur Sargent	26th Sep.	27th Mar. 1884			
	Ditto H. McCalman	28th Mar. 1884	31st Mar.			
Zanzibar	Ditto M. L. Bartholomeuz	1st April 1883	26th Nov. 1883			
	No Superintendent	27th Nov.	31st Mar. 1884			
Karwar	R. G. C. Westbrook, Esq.	1st April	31st Mar.			
Calicut	Henry Richardson, Esq.	1st April	31st Mar.			

Voluntary.
Storm-
warning
Service.

APPENDIX G.

Extracts from the Administration Report of the Meteorological Reporter to the Government of Madras for the year 1883-84.

During the official year under report observations were recorded as usual three times daily, *viz.*, at 10 A.M., 4 P.M., and 10 P.M., at twelve observatories, and twice daily, leaving out the 10 P.M. records, at 5 third class observatories. A new third class observatory was opened at Cuddapah on the 23rd of March 1884, and fresh instruments were provided wherever needed. Three of the observatories were inspected during the year.

A copy of the Madras Observatory Meteorological Register for each month is handed over to the Meteorological Reporter for the Presidency, which obviates the necessity of a separate record being maintained. No changes were made in the instruments used during the year. The following are the observatories which furnish meteorological registers :—

Madras.	Cuddapah.	Negapatam.
Amini Divi.	Kurnool.	Rajahmundry.
Bangalore.	Madura.	Salem.
Bellary.	Mangalore.	Secunderabad.
Cochin.	Masulipatam.	Trichinopoly.
Coimbatore.	Mercara.	Wellington.

Amini Divi (Laccadives).—The observations taken at this observatory were still very unsatisfactory, and the records that can be utilised this year are those of the barometer and dry and wet bulb thermometers.

The remuneration allowed to the Hospital assistant for his meteorological duties was withdrawn last year when the observations proved so unreliable, and he has since been transferred to another station, but, prior to this change, his successor, Syed Laul, was permitted by the Medical Department to attend my office for instruction in the additional meteorological work required. He came daily for about a month, during which time he was also taught to reduce the observations. The pay of the assistant at this observatory has been doubled, conditionally, that is, if the records and reductions prove satisfactory on revision at the Madras Office. A fresh anemometer was sent to Amini Divi by the new assistant, but, on arriving at his destination, he reported that one of the cups had come off.

Bangalore.—As usual, the work at this observatory has been very good throughout the year. No new instruments were required; the records were unbroken, and the assistant reduced and forwarded his observations with care and punctuality.

Bellary.—The ordinary observations three times a day; hourly observations on four days in each month, and the synoptic observations taken at the local time, corresponding to 7 A.M., Washington mean time, for the "United States International Weather Bulletin" were all carried on satisfactorily throughout the year.

I inspected this observatory on the 21st, 22nd, and 23rd of March last. The barometer was clean and in very good order, but the room in which it is placed is rather too small. The thermometer shed required a good many alterations, but, as Dr. Archdall informed me that it was under consideration to remove the Civil Dispensary some little distance off, and that all the meteorological instruments will have to be disturbed, I thought it better to defer the less important improvements

till later on. The thatching on the roof of the shed was scarcely thick enough, and the sides, instead of being open, were screened off by mats to within 3 feet of the south end, which, of course, prevented the free circulation of air. This, however, was soon taken down and set right, as at other observatories. Instead of neat posts and tarred ropes of telegraph wires to protect the shed and instruments from cattle, &c., there were only unsightly bamboo posts and string; these, however, will remain until the change. With the exception of the wet minimum, the thermometers were in fair order.

* * * *

As at all other observatories lately inspected, I substituted a teakwood thermometer cage for the open board on which the instruments had hitherto been placed, but only found it necessary to change one thermometer, the wet minimum. The assistants have worked better this year, reducing their observations thoroughly, but the delay in forwarding the reduced registers to me, frequently, six months in arrears, has still been a matter of complaint and serious inconvenience. In other respects I believe both the assistants do their best. No grass thermometer pad has ever been in use at this observatory, and, as there was not the least appearance of any grass under the thermometer, I think this fact accounts in a measure for the readings of the latter instrument sometimes exceeding those of the wet minimum. The present position of the thermometer shed is not a good one, being too near the Civil Dispensary, nor do I consider the anemometer sufficiently high. The new site pointed out to me by Dr. Archdall will doubtless be a great improvement upon the old one, being more open, and the anemometer will, it is hoped, also be raised a few feet, so that the surrounding trees will have no effect upon its readings.

Cochin.—The observations at this observatory have been continuous throughout the year, with the exception of the grass minimum thermometer, which was broken on the 30th of April, and could not be replaced owing to the insufficiency of the instruments in store at Madras. The readings of the anemometer are still unreliable, and, though a new instrument by Casella, previously compared with the Madras Observatory anemograph, was supplied, there was no improvement in the records. On further enquiry I was informed that the position of the instrument was most unsuitable, being fixed to the northern pole of the shed and only about 2 feet higher. There is also a near building almost facing the shed, and a large tree within a few yards; these, no doubt, prevent any accurate measurements of the velocity. I intend inspecting this observatory before long, when I hope to remedy the defects and make such improvements as may be found desirable.

The assistant employed at this observatory since November 1880 was transferred to the Madras Office in August, and M. V. Eippe appointed in his place. This new assistant, formerly employed in the Postal Department, had undergone the usual instruction at this office while on privilege leave, and since joining his appointment has worked very creditably.

Coimbatore.—The work at this observatory has been satisfactory throughout the year. The barometer and thermometers were in good order, and no new ones required. The anemometer is worn, and needs replacing, but its position is not satisfactory: and pending the construction of a staging on which the new instrument can be placed, the old one has been recorded. The assistant has reduced his observations regularly and carefully, and has been allowed to remain in the service a few months longer, though his age now necessitates early retirement.

Cuddapah.—A new third class observatory was started at this station on the 23rd of March 1884. A thermometer shed of the usual dimensions and design, together with as many instruments as were available from this office, were sent in charge of T. Vythianatha Iyer, first assistant, who, with the aid of the Executive Engineer, saw the shed erected, placed the thermometers in the cage, and taught an assistant the duties required of him. On the 25th of March I inspected this observatory myself, and was very well satisfied with all the arrangements. The shed occupies a good open position at the east end of the hospital compound, and there are fortunately neither trees nor buildings near enough to have any effect upon the readings of the instruments. As there were no good barometers, or sun and grass thermometers in store at Madras, the Meteorological

Reporter to the Government of India was requested to furnish these instruments from Calcutta, but they had not arrived at the time of my inspection. The medical officer in charge showed me the room in which he proposed placing the barometer, a very suitable one in every respect, and the instrument has since been received and placed there. The height of the cistern of the barometer, as ascertained by the Executive Engineer, is 433'36 feet above mean sea-level. The assistant appointed to take the observations is a man who can give his whole time to the meteorology, and will not be liable to be changed. The system of employing men who have other duties to perform and are likely to be transferred, has proved very objectionable and detrimental to one or two observatories of this Presidency, and, as there are numbers of applicants for vacant posts, I find no difficulty in getting assistants upon Rs. 15 per month. No anemometer is in use at this station at present, but, as it is proposed to place this instrument on the roof of the hospital, an inexpensive stand and ladder will be all that is necessary, and I hope this will soon be ready, and the records of all the instruments rendered complete.

Kurnool.—The work at this third class observatory was carried on steadily till October 1883 when the telegraph master was transferred, and a native postmaster, who had received no instructions regarding the observations, took charge. Since then the maximum readings of the thermometer have been unreliable, and the whole work deteriorated. Postmaster V. Venhateshazza has applied to me to be allowed to resign his meteorological duties, and as soon as a new assistant, now under instruction at my office, is qualified, he will relieve the present postmaster. As the new assistant will have no other work, I shall be able to report more satisfactorily regarding this observatory in future reports.

Madura.—A break in the records of the wet bulb thermometer occurred from the 5th of March 1883 till the 4th of June, when another was supplied, but with this exception there has been no change in this observatory during the year.

Mangalore.—The work of this observatory has been carried on without interruption throughout the year, and the instruments appear to have been kept in good order, and no new ones required. Weekly records of the observations are forwarded to me by the telegraph master in charge.

Masluipatam.—The work at this observatory has been carried on without any breaks in the records, but the barometric readings were evidently wrong for some time, and though a new instrument was supplied from Calcutta in March of this year, there has been little improvement. The assistant only reduced his observations for two or three months during the year, and even then they were so incorrect that I had to set the Madras Meteorological Office assistants to do the work over again for those months. Since March his salary has been reduced to half, but even this has failed to realise any improvements, and, in consequence, he will soon be superseded by a more competent and willing man.

Mercara.—No new instruments were needed at this observatory, and the work has been carried on in a satisfactory way throughout the year. Weekly records of the observations are regularly furnished to this office.

Nagapatam.—The observations were carried on without any interruption throughout the year, and the instruments appear to have been in good order. During heavy rain the readings of the grass minimum have occasionally exceeded those of the wet minimum by a degree or even more. The assistant has worked well, reducing his observations more carefully than formerly.

Salem.—This observatory has kept its good reputation throughout the year. No new instruments were required, and the assistant has reduced his observations satisfactorily and forwarded them punctually to this office.

Secunderabad.—This observatory was inspected on the 17th of March last, when I altered the arrangement of the thermometers, exchanging the thermometer board hitherto in use for a teakwood and wire cage, similar to those now used at all the observatories visited since the Department has been under my care. The general condition of the observatory was very satisfactory and highly creditable to both the medical officer in charge and his assistant. The barometer and all the other

instruments were clean and in perfect order. The shed will require renovating and painting before long, and the railings which enclose the raingauge and radiation thermometers will be better extended right round the shed to prevent cattle when grazing near, from making an occasional meal of the thatching from the roof (an estimate for this little improvement had been submitted to me prior to my visit), and I understand the assistant has frequently had to watch the shed to prevent this from occurring. With the exception of the dry maximum thermometer, which was replaced by another in December, and the sun maximum thermometer broken in January, the remaining instruments were in good order throughout the year. The observations have been carefully and accurately reduced by the new assistant since his appointment, and this observatory, formerly the worst, now ranks as one of the best in the Presidency.

Trichinopoly.—The observations of this second class observatory have been carried on without any breaks all through the year under report, but the continued obstinacy of the assistants in not furnishing this office with the reductions till many months have elapsed is still a source of complaint, and has even delayed the publication of this Annual Report, as the table of yearly means and extremes cannot be completed until all the registers from up-country observatories have been received and revised.

Wellington.—No changes have been made in any of the instruments in use at this observatory, and the work has been carried on satisfactorily throughout the year, with the exception of three days in December, the 8th, 9th, and 10th, on which occasions the records were missed, owing to the indisposition of the acting assistant during the absence, on leave, of Serjeant Brownsell. As the medical authorities required the room which had hitherto been given up to the assistant as a meteorological office, and in which the barometer had been kept, this instrument was removed to another room on the same floor, at the back of the hospital after the 10 P.M. reading on the 31st of January.

The general work of the observatories of the Madras Presidency has been satisfactory during the year. With the exceptions of Cochin and Kurnool there have been no changes in the assistants. The observations have been reduced, some partially and others completely, by all the assistants, excepting the one at Masulipatam, and since the commencement of 1884 I am pleased to be able to report a still further improvement with regard to the registers. It has, however, been a difficult matter to get the assistants drawing the higher rate of salary to complete their work, and the inaccuracy of some of the figures at first necessitated complete revision at my office.

The list of new instruments supplied is considerably smaller this year when compared with that in last year's report.

* * * * *

The establishment of the Madras Meteorological Office has been increased by the sanction of a copying clerk, a very necessary addition, and one that will enable me to keep the work up to date in future. The following is the present staff employed at my office:—

T. Vythianatha Iyer	.	.	.	.	.	.	.	First Assistant.
N. E. Kangayam Pillay	.	.	.	.	.	.	.	Second „
N. Narayansawmy	.	.	.	.	.	.	.	Third „
David John	.	.	.	.	.	.	.	Fourth „
Bungaroo	.	.	.	.	.	.	.	Peon.

Revenue Board Rain Reports have been received as usual by the Government Astronomer, and the results tabulated in the Supplement to the *Fort St. George Gazette* * * *

* * * The rain stations have not yet been handed over to the Meteorological Reporter.

ELIZABETH ISIS POGSON, F. R., MET. SOC.,
Meteorological Reporter to the Government of Madras.

METEOROLOGICAL OFFICE,
Madras, 15th July 1884.

APPENDIX G II.

List of Officers in charge and Assistants in the Madras Presidency, Meteorological Department, in the official year 1883-84.

Station.	Officer in charge.	From	To	Assistant.	From	To
Amini Divi	Syed Abdool Rahaman	22nd Dec. 1879	5th Feb. 1884			
	Syed Laul	6th Feb. 1884	31st Mar.			
Bangalore	Surgeon P. H. Benson, M.B.	1st April 1881	14th Sep. 1883	Rungasawmy Moodeliar	1st Sep. 1871	31st Mar. 1884
	" A. F. Dobson, M.B.	15th Sep. 1883	19th Feb. 1884			
	Surgeon-Major J. North	20th Feb. 1884	31st Mar.			
Bellary	" H. M. G. Archdall	11th Feb. 1881	31st Mar.	B. G. Sashachellum, First	31st Aug. 1878	31st Mar.
				Sreenivasa Row, Second	21st Dec. 1881	31st Mar.
Cochin	Brigade-Surgeon W. H. Morgan	24th May 1882	31st Mar.	G. Narayanasawmy	7th Nov. 1880	17th Aug. 1883
Coimbatore	Surgeon-Major J. F. Fitzpatrick, M.D.	2nd May	31st Mar.	M. V. Eippe	18th Aug. 1883	31st Mar. 1884
Cuddapah	Surgeon G. Iyasawmy	15th Mar. 1884	31st Mar.	Varadiah Naidu	1st July 1877	31st Mar.
Kurnool	Telegraph Master A. Wale	12th Feb. 1883	12th Aug. 1883	V. A. Vyaravulu Moodeliar	15th Mar. 1884	31st Mar.
	" A. Holmes	13th Aug.	19th Oct.			
	Post and Telegraph Master V. Venkateshazza.	20th Oct.	31st Mar. 1884			
Madura	Surgeon-Major W. J. Hastings, M.D.	16th Oct. 1882	31st Mar.	V. Sashachellum	19th Nov. 1867	31st Mar.
Mangalore	Telegraph Master F. D'Souza	22nd Aug. 1880	17th Jan.			
	" A. Ramarow	18th Jan. 1884	9th Feb.			
	" R. S. D'Souza	10th Feb.	31st Mar.			
Masulipatam	Surgeon H. St. Clare Carruthers	9th April 1882	8th Nov. 1883	Uma Ranganayakulu Naidu	1st Aug. 1868	31st Mar.
	Surgeon-Major J. H. Ritchie	9th Nov. 1883	31st Mar. 1884			
Mercara	Telegraph Master H. Duckworth	29th Mar. 1880	21st Jan.			
	Deputy Tel. Master T. S. Arunachellum	22nd Jan. 1884	26th Jan.			
	Telegraph Master H. Duckworth	27th Jan.	3rd Mar.			
	Deputy Tel. Master T. S. Arunachellum	4th Mar.	18th Mar.			
	Telegraph Master H. Duckworth	19th Mar.	31st Mar.			

List of Officers in charge and Assistants in the Madras Presidency, Meteorological Department, in the official year 1883-84.

Station.	Officer in charge.	From	To	Assistant.	From	To
Negapatam	Surgeon E. A. Morris, L.R.C.P.	13th Nov. 1880	31st Mar. 1884	S. Saminatha Iyer	5th Sep. 1874	31st Mar. 1884.
Salem	Surgeon-Major H. J. Hazlett	26th May 1882	.....	L. Ramsing	13th Oct. 1880	31st Mar. "
	Do. A. L. Hackett	.....	31st Mar. 1884.			
Secunderabad	Do. E. Fawcett, F.R.C.S.	1st April 1883	6th April 1883	J. F. Williams	27th Feb. 1882	31st Mar. "
	Surgeon G. F. Bevan	7th April "	6th July "			
	Surgeon-Major E. Fawcett, F.R.C.S.	7th July "	12th Oct. "			
	Do. T. C. H. Spencer	5th Nov. "	7th Nov. "			
	Surgeon G. F. Bevan	8th Nov. "	14th Dec. "			
	Surgeon-Major T. C. H. Spencer	15th Dec. "	31st Mar. 1884.			
Trichinopoly	Do. J. B. Thomas, L.R.C.P.L.	3rd Dec. 1879	12th July 1883	T. Lutchman Row, First	21st Nov. 1874	31st Mar. "
	Surgeon J. L. Evan Gezzel, M.D.	13th July 1883	26th July "	E. M. Bhajarajooloo Naidee, Second	1st December 1881	31st Mar. "
	Surgeon-Major L. C. Nanney	27th July "	31st Mar. 1884.			
Wellington	Do. A. Long, M.D.	3rd Nov. 1882	24th Oct. 1883	Sergeant H. Brownsell	1st August 1880	31st Mar. "
	Surgeon R. T. Beamish, M.D.	25th Oct. 1883	16th Nov. "			
	Surgeon-Major C. F. Churchill, M.D.	17th Nov. "	31st Mar. 1884.			

APPENDIX H.

Report on the Administration of Meteorological Observatories in British Burma by the Sanitary Commissioner.

During the year all the Observatories in the province were inspected by me—

- 2nd class, Rangoon, on 12th February 1884.
- 3rd class, Bassein, on 13th and 14th June 1883.
- 3rd class, Thayetmyo, on 12th October 1883.
- 3rd class, Moulmein, on 20th December 1883.
- 3rd class, Mergui, on 9th December 1883.
- 3rd class, Toungoo, on 2nd August 1883.

The position of the last-named has since my inspection been changed from the Military Hospital Compound to that belonging to the Civil Dispensary.

All records were found up to date and appeared to be accurately kept.

Instruments, with the following exceptions, were clean, well-placed, and in good working order.

At Rangoon the clock-work in connection with the anemograph had stopped since 10 A.M. on the day of inspection. The observer explained that cockroaches and other vermin constantly get amongst the gearing and bring the clock-work to a standstill. Such alterations were recommended as, it is hoped, will prevent a recurrence of similar accidents. The wind-vane appeared to be working stiffly, and an officer of the Public Works Department was asked to put it to rights.

At Bassein the solar radiation thermometer had been broken by a monkey. It has since been replaced.

At Mergui the grass radiation thermometer had been broken by a piece of bone believed to have been dropped by a crow or other large bird.

At Moulmein, the grass radiation thermometer had been accidentally broken.

The accompanying lists show—

- (a) The Superintendents and Observers for the year.
- (b) The instruments issued to each Observatory.*

RANGOON,
5th July 1884.

D. SINCLAIR, M.D.,
Sanitary Commissioner, British Burma.

* This is incorporated in the general return in Appendix K.

APPENDIX H II.

Return showing the names of Superintendents and Observers of the Meteorological Observatories in the Province of British Burma for the year 1883-84.

Name of Station.	Designation of Officer.	Name and Rank of Officer.	Term of Service.
Rangoon	Superintendent	Surgeon-Major H. Johnstone, M.D.	From 22nd April 1880 to 27th August 1883.
	Offg. Ditto	Ditto O. Baker	„ 28th August to 27th November 1883.
	Ditto	Ditto H. Johnstone, M.D.	„ 28th November and 29th November 1883.
	Offg. Ditto	Ditto O. Baker	„ 30th November 1883 to 15th January 1884.
	Superintendent	Ditto H. Johnstone, M.D.	„ 16th January to 31st March 1884.
	Observer	G. E. Wales	„ 1st August 1882 to 31st March 1884.
	Assistant Observer	Meh Nego	„ 1st December 1882 to 15th September 1883.
Bassein	Ditto	O. White	„ 16th September 1883 to 31st March 1884.
	Superintendent	Surgeon S. H. Dantra, M.D.	„ 1st November 1881 to 31st March 1884.
	Observer	Moung Hpay	„ 14th February 1883 to 31st March 1884.
Thayetmyo	Superintendent	Surgeon O. Baker	„ 1st April to 25th August 1883.
	Ditto	Ditto E. P. Frenchman	„ 26th August 1883 to 26th February 1884.
	Ditto	Ditto Charles W. E. Foster	„ 27th February to 31st March 1884.
	Observer	Mirza Mahomed Tphya Begg, 3rd Class Hospital Assistant.	„ 1st April to 31st December 1883.
	Ditto	Alla Deen, 2nd Class Hospital Assistant.	„ 1st January to 31st March 1884.
Moulmein	Superintendent	Surgeon-Major W. F. de Fabeck, M.D., Civil Surgeon.	} Throughout the year.
	Observer	F. St. Hilbert, Hospital Assistant	
Mergui	Superintendent	Hospital Assistant Rajub Ally	From 1st to 13th April 1883.
	Ditto	Uncovenanted Medical Officer, Paul George Paul.	„ 14th April 1883 to 31st March 1884.
	Observer	Moosajee	„ 1st April 1883 to 31st March 1884.
Toungthoo	Superintendent	Surgeon Maurice Smith	„ 1st April to 30th July 1883.
	Ditto	Ditto P. W. Dalzell	„ 31st July to 31st March 1884.
	Observer	1st Class Hospital Assistant M. Baboo Pillai.	„ 1st April 1883 to 31st March 1884.

D. SINCLAIR, M.D.,
Sanitary Commissioner, British Burma.

APPENDIX I.

Return of the Stock and Issue of Instruments for the year 1883-84.

Instruments.	In Store on 1st April 1883.	Received 1883-84.	Issued 1883-84.
Van Rysselberghe's meteorograph	1	...	...
Barometers, observatory, Fortin's principle	8	5	5
Do. do. Kew principle	3	28	23
Do. mountain, portable tripod (Adie)	18	5	11
Do. marine, Kew principle	22	1	14
Do. Newman's, large standard	2	...	...
Do. do. small standard	3	3	4
Do. Negretti and Zambra (various)	7	2	5
Aneroids	19	2	2
Thermometers standard with attached scales	20	...	3
Do. without attached scales (chemical)	1	...	...
Do. for hygrometers (Kew pattern)	80	52	63
Sling thermometers	10	...	...
Thermometers, maximum, for shade	123	16	51
Sun thermometers not in vacuo	2	...	...
Thermometers minimum for shade	52	44	46
Do. do radiation	31	25	33
Six's thermometers . . . . .	...	6	...
Thermometers, solar, in vacuo	38	33	13
Frankland's sun thermometer . . . . .	...	6	1*
Ponillet's pyrheliometer	1	...	...
Stewart's actinometers (thermometers for) . . . . .	...	12	12
Lenses for actinometers . . . . .	...	3	3
Hodgkinson's do.	2	...	...
Herschell's do.	1	...	...
Regnault's hygrometer	3	...	...
Daniell's do.	10	...	...
Halleur's do.	5	...	...
Boiling point thermometers	6	1	...
Pocket spectroscopes (Browning's)	2	...	...
Wind vanes	17	14	23
Anemometers	26	45	43

* Broken.

Return of the Stock and Issue of Instruments for the year 1883-84—continued.

Instruments.	In Store on 1st April 1883.	Received 1883-84.	Issued 1883-84.
Beckley's anemographs	2	...	...
Raingauges (Symons' and Glaisher's)	6	37	33
Measure glasses for do.	18	72	55
Reading lenses	3	1	3
Sun thermometer stands	20	...	6
Radiation pads	3	5	8
Thermometer cages	4	27	28
Do. for ships	15	...	...
Prismatic compass	1	...	...
Sand glasses (3 minutes)	5	80	39
Sunshine recorder	1	...	...
Bull's eye lantern	1	...	...
Salinometers	36	...	...
Common thermometers, brass scales	28	...	1
Clocks	2	8	8
Watches . . . . .	...	2	1
Spirit level	1	...	...
Hick's barograph	1	...	...
Thermograph with Negretti's and Zambra's sets of recording thermometers	1	...	...
Sundials . . . . .	...	2	2
Magnetic compasses (pocket) . . . . .	...	4	4

APPENDIX K.

Return of the Instruments issued to each Observatory in 1883-84.

Provinces.	STATIONS.	Barometers.	HYGRO- METERS.		Dry maximum thermo- meters.	MINIMUM THERMO- METERS.		RADI- ATION THER- MOMETERS.		Anemometers.	Wind Vanes.	Raingauges.	Measure-glasses.	Lenses.	Clocks.	Sand-glasses.	Stands for sun thermome- ters.	Pads for grass radiation thermometers.	Cages.	Standard thermometers.		Compasses.	Sundials.	REMARKS.
			Dry bulb.	Wet bulb.		Dry.	Wet.	Solar.	Grass.											...	...	
AFRI- CA.	Zanzibar . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1*	...	* In lieu of one lost.	
PER- SIA.	Bushire . . . . .	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
BELOO- CHISTAN	Quetta . . . . .	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...
	Chamba	4	1	1	1	1	1	...	1	1	1	1	2	...	1	...	...	1	1	...	...	...	...	Original furniture.

Return of the Instruments issued to each Observatory in 1883-84—continued.

Provinces.	STATIONS.	Barometers.	HYGROMETERS.		Dry maximum thermometers.	MINIMUM THERMOMETERS.		RADIATION THERMOMETERS.		Anemometers.	Wind Vanes.	Rain-gauges.	Measure-glasses.	Lenses.	Clocks.	Sand-glasses.	Stands for sun thermometers.	Pads for grass radiation thermometers.	Cages.	Standard thermometers.	Compasses.	Sundials.	REMARKS.
			Dry bulb.	Wet bulb.		Dry.	Wet.	Solar.	Grass.														
CASHMERE.	Leh	I	12 thermometers for actinometers and three lenses have been sent to Mr. Hennessey at Mussooree for verification.
PUNJAB.	Kailang	I	* New Instruments.
	Lahore . . . . .	...	...	...	...	...	...	2†	1†	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mooltan . . . . .	...	...	...	...	...	...	1†	...	...	...	...	...	...	I	1†	...	...	...	...	...	...
	Dera Ismail Khan . . . . .	...	...	...	...	...	...	...	1†	...	...	...	...	...	...	1†	...	...	...	...	...	...
	Peshawar . . . . .	...	...	...	...	...	...	1†	...	...	...	...	...	...	...	1*	...	...	...	...	...	...
	Rawalpindi . . . . .	...	...	...	...	...	...	...	1*	...	...	...	...	...	...	1*	...	...	...	...	...	...
	Murree . . . . .	...	...	...	...	...	...	...	3†	1†	1†	...	...	...	...	1*	...	...	...	...	...	...
	Sealkot . . . . .	...	...	...	...	...	1†	...	1†	...	...	...	...	...	...	1†	...	...	...	...	...	...
	Ludhiana . . . . .	...	...	...	1†	...	1†	...	...	...	...	...	...	...	...	1†	...	...	...	...	...	...
	Sirsa . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1†	...	...	...	...	...	...
N.-W. P. AND OUDH.	Delhi	1†	† Substituted for old ones. ‡ Substituted for broken ones.
	Simla . . . . .	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Allahabad {Muir College New observatory . . . . .	...	...	...	I	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Meerut . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Agra . . . . .	...	...	...	...	...	...	...	I	I	...	...	...	...	...	...	...	...	...	...	...	...
	Roorkee	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mussooree . . . . .	...	...	...	I	...	...	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...
	Lucknow . . . . .	...	...	...	...	...	...	I	...	...	...	...	...	...	...	...	I	...	...	...	...	...
	Ranikhet . . . . .	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	I	...	...	...	...	...
	Bareilly . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
ASSAM.	Chakrata	I	I	§ For ground observations.
	Benares . . . . .	...	...	...	...	...	...	...	I	...	...	...	...	...	...	I	...	...	...	...	...	...
	Gorakhpur . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	I	...	...	...	...	...	...
	Jhansi . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	I	...	...	...	...	...
	Sibsagar . . . . .	...	...	...	I	...	...	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...
BENGAL.	Dhubri	I	To replace defective instruments.
	Silchar . . . . .	...	...	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...	...
	Purneah . . . . .	...	...	...	...	...	...	...	I	...	...	...	...	...	...	I	...	...	...	...	...	...
	Burdwan . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	I	...	...	...	...	...	...
	Darjeeling (St. Paul's School) . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	I	...	...	...	...	...
BENGAL.	Durbhanga	
	Patna . . . . .	...	...	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...	...
BENGAL.	Gya	I	I	I	I	

Return of the Instruments issued to each Observatory in 1883-84—contd.

Province.	STATIONS.	Barometers.	HYGRO-METERS.		Dry maximum thermometers.	MINIMUM THERMO-METERS.		RADIATION THERMO-METERS.	Anemometers.	Wind Vanes.	Raingauges.	Measure-glasses.	Lenses.	Clocks.	Sand-glasses.	Stands for sun thermometers.	Pads for grass radiation thermometers.	Cages.	Standard thermometers.	Compasses.	Sundials.	REMARKS.
			Dry bulb.	Wet bulb.		Dry.	Wet.															
BENGAL—contd.	Hazaribagh . . . . .	...	...	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...
	Jessore . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	I	...	...	...	...
	False Point	I	...	...	...	...	...	...	I*	...	...	...	...	...	I	...	...	...	...	...	...
	Chittagong . . . . .	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Saugor Island . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	I	...	...	...	...
	Gopalpore . . . . .	...	...	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...
	Balasore	I	I	I	I	I	...	...	I*	I	I	I	...	...	...	...	...	...	...	...	...
	Midnapore	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Raneegunge	I	I	I	I	I	...	...	I	I	I	I	...	I	...	...	...	...	...	...	...
	Noakhally	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...	* To replace defective instruments.
	Burrisaul	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Serajunge	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Commillah	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Furreedpore	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Mymensing	I	3	2	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Rampore Beaulah	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Dinagepore	I	I	I	I	I	...	...	I	I	I	I	...	I	...	...	...	...	...	...	...
	Rungpore	I	I	I	I	2†	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...	† One out of order in transit.
	Julpigoree	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Bhāgulpore	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Chupra	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Motihari	2	I	I	2	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Buxar	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Arrah	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Dehree	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Nya Doomka	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Ranchee	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
	Chyebassa	I	I	I	I	I	...	...	I	I	I	I	...	...	...	...	...	...	...	...	...
CENTRAL PROVINCES.	Nagpur . . . . .	...	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Jubbulpore	3	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Pachmarhi . . . . .	...	...	...	...	...	...	...	3	...	...	I	...	...	...	...	...	...	...	...	...
	Saugor . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	I	...	...	...	...	...	...
	Hoshangabad	I	...	...	...	...	...	...	...	...	...	...	...	...	I	...	...	...	...	...	...
	Khandwa . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	I	...	...	...	...	...	...
	Seoni . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	I	...	...	...	...	...	...
	Raipur	I	...	I	...	...	I	...	I	...	...	...	...	...	I	...	...	...	...	...	...
	Sambalpore	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Chanda . . . . .	...	...	...	...	...	...	...	I	...	...	I	...	...	...	...	...	...	...	...	...

Return of the Instruments issued to each Observatory in 1883-84—contd.

Province.	STATIONS.	Barometers.	HYGRO-METERS.		Dry maximum thermo-meters.	MINIMUM THERMO-METERS.		RADIATION THERMO-METERS.		Anemometers.	Wind Vanes.	Raingauges.	Measure-glasses.	Lenses.	Clocks.	Sand-glasses.	Stands for sun thermometers.	Pads for grass radiation thermometers.	Cages.	Standard thermometers.	Compasses.	Sundials	REMARKS.
			Dry bulb.	Wet bulb.		Dry.	Wet.	Solar.	Grass.														
BERAR.	Chikalda	1*	* In lieu of one out order.
	Akola . . . . .	...	...	...	...	...	...	1*	...	...	...	...	...	...	1*	...	...	...	...	...	...	...
	Amraoti . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1*	...	...	...	...
CENTRAL INDIA.	Indore	1*	† In lieu of one broken.
	Bickaneer . . . . .	...	...	1*	...	...	...	1†	...	...	...	...	...	...	...	...	...	...	...	...	...	...
RAJPUTANA.	Sambhar	2	1	‡ One watch and one clock.
	Ajmere . . . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Pachbudra . . . . .	...	...	...	...	...	...	2	1	...	...	...	...	...	2†	...	...	...	...	...	...	...
BOMBAY.	Jacobabad	1*	§ In lieu of one stolen.
	Hyderabad . . . . .	...	...	1*	...	...	...	1†	1*	...	...	...	...	...	...	...	...	...	...	...	...	...
	Kurrachee . . . . .	...	...	...	...	...	...	1†	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bhuj . . . . .	...	...	...	1†	...	...	...	1*	...	...	...	...	...	...	...	...	...	...	...	...	...
	Deesa . . . . .	...	...	...	...	...	...	1†	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Rajkot . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...
	Malegaon . . . . .	...	...	...	...	...	...	1†	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Poona . . . . .	...	...	...	...	...	...	1†	...	...	...	1†	...	...	...	...	...	...	...	...	...	...
	Sholapur (old obsy.) . . . . .	...	...	...	...	...	...	1†	...	...	...	...	...	...	...	1§	...	...	...	...	...	...
	„ (new „)	1	1	1	1	1	1	1	1	1	...	1	1	...	...	...	1	2	...	...	1	...
	Belgaum . . . . .	...	...	...	...	...	1†	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ratnagiri . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1*	...	...	...	...
	Karwar . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	2*	...	...	...	...	...	...	...
	Baroda	1	1	1	1	1	1	1	1	1	...	1	1	...	...	1	1	2	...	...	1	...
	Bellary . . . . .	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Trichinopoly . . . . .	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
MADRAS, MYSORE, AND COORG.	Masulipatam	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Madura . . . . .	...	1	1	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...
	Salem . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...
	Coimbatore . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...
	Wellington . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...
	Negapatam	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bangalore . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...
	Kurnool . . . . .	...	...	...	...	...	1	1	1	...	...	...	...	...	...	1	...	...	...	...	...	...
	Cuddapah	1	1	1	1	1	1	1	1	...	1	1	1	...	...	...	1	1	...	...	...	...
	Rajamundry	1	...	...	...	...	...	1	1	...	...	...	...	...	...	...	1	1	...	...	...	...
	Secunderabad . . . . .	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mercara . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Amini Divi . . . . .	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...

Return of the Instruments issued to each Observatory in 1883-84—concl'd.

Province.	STATIONS.	Barometers.	HYGROMETERS.		Dry maximum thermometers	MINIMUM THERMOMETERS.		RADIATION THERMOMETERS.		Anemometers.	Wind Vanes.	Raingauges.	Measure-glasses.	Lenses.	Clocks.	Sand-glasses.	Stands for sun thermometers.	Pads for glass radiation thermometers.	Cages.	Standard thermometers.	Compasses.	Sundials.	REMARKS.
			Dry bulb.	Wet bulb.		Dry.	Wet.	Solar.	Grass.														
BURMA.	Rangoon	* Replacing those stolen from observatory.
	Thyetmio . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bassein . . . . .	...	...	...	1*	1*	1*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Toungahoo . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Moulmein . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mergui . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Port Blair . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Nancowry . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Alipore . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	F. L. V. Planet . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
DAY ISLANDS.	Dehra (Forest School)	† Frankland's sun thermometer. ‡ Beckley's self-registering anemometer.
	Ajmere (Forest Dept.) . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Makhla . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mominabad . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Erinpura . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Lohardugga . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Cuttack (Tributary Mehals) . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		
		
		

APPENDIX L.

List of Recipients of the Publications of the Meteorological Office.

Adelaide	Meteorological Observatory.
Agra	The Editor of the <i>Delhi Gazette</i> .
Ajmere	Chief Commissioner of Ajmere.
Akola	Sanitary Commissioner for Berar.
Algeria	Director of the Meteorological Service of the Ecole des Sciences d'Alger.
Allahabad	Secretary to the Government, North-Western Provinces and Oudh.
	Department of Revenue and Agriculture, North-Western Provinces and Oudh.
	Meteorological Reporter, North-Western Provinces and Oudh.
	Sanitary Commissioner, ditto ditto.
Amsterdam	Editor of the <i>Pioneer</i> .
	The Accountant-General, North-Western Provinces and Oudh.
Bangalore	Royal Academy of Sciences.
Batavia, Java	Chief Commissioner, Mysore and Coorg.
	Conservator of Forests, Mysore and Coorg.
Berlin	Meteorological Observatory.
Bombay	Ditto Institute.
	Secretary to the Government of Bombay.
	Meteorological Reporter for Western India.
	Colaba Observatory.

List of Recipients of the Publications of the Meteorological Office—continued.

	Sanitary Commissioner with the Government of Bombay.
	Bombay University.
	Asiatic Society of Bombay.
Bombay— <i>contd.</i>	Sassoon Mechanic's Institute.
	Geographical Society of Bombay.
	Editor of the <i>Bombay Gazette</i> .
	Ditto <i>Times of India</i> .
	Elphinstone College.
Brisbane, Queensland	Observatory.
Brussels	Royal Academy of Sciences.
	Observatoire Royal.
Budapesth	Observatory.
	Secretary of State for India (through Revenue and Agricultural Department).
	Secretary to the Government of India, Revenue and Agricultural Department.
	Ditto ditto Home Department.
	Ditto ditto Public Works Department.
	Ditto ditto Foreign Department.
	Ditto ditto Department of Finance and Commerce.
	Ditto ditto Military Department.
	Private Secretary to His Excellency the Viceroy.
	Secretary to the Government of Bengal, Revenue Department.
	Meteorological Reporter to the Government of Bengal.
	Surveyor General of India.
	Superintendent, Geological Survey of India.
	Sanitary Commissioner with the Government of India.
	Ditto ditto ditto Bengal.
	Superintendent, Botanical Gardens, Calcutta.
Calcutta	Inspector-General of Forests, with the Government of India.
	Surgeon-General ditto ditto.
	Asiatic Society of Bengal.
	Indian Museum Library.
	Calcutta University.
	Presidency College.
	Public Library.
	Editor of the <i>Calcutta Review</i> .
	Ditto <i>Statesman and Friend of India</i> .
	Ditto <i>Englishman</i> .
	Ditto <i>Indian Daily News</i> .
	Ditto <i>Hindu Patriot</i> .
	Ditto <i>Indian Agriculturist</i> .
	St. Xavier's College Observatory.
	The Alipore Observatory.
	Mint Master.
	Indian Association for the Cultivation of Science.
Cambridge	University Library (through H.M.'s Secretary of State for India).
Cambridge, Massachusetts	Harvard University.
Cape of Good Hope	Astronomer Royal.
Carlsruhe, Baden, Germany	Bureau für Meteorologie und Hydrographie.
Chemnitz	Royal Meteorological Institute.
Chatham	Royal Engineer's Library (through Revenue and Agricultural Department).
Christiania	Norske Meteorologiske Institut.
	Royal Observatory.
	Editor of the <i>Ceylon Times</i> .
Colombo	Ditto <i>Ceylon Observer</i> .
	Surveyor General of Ceylon.

List of Recipients of the Publications of the Meteorological Office—continued.

Constantinople	Observatoire Impérial Météorologique.
Copenhagen	Danske Meteorologiske Institut.
Cordoba	Royal Danish Academy of Sciences.
Darjeeling	Meteorological Office.
Dehra Dun	Conservator of Forests, Government of Bengal.
Dharwar	Editor of the <i>Indian Forester</i> .
Dublin	Superintendent, Great Trigonometrical Survey.
Dacca	Conservator of Forests, Bombay, Southern Division.
Edinburgh	Royal Dublin Society.
Ellichpore	Dacca College.
Goa	Scottish Meteorological Society.
Greenwich	Astronomer Royal for Scotland, Royal Observatory.
Guatemala	Assistant Conservator of Forests, Melghat Division.
Hamburgh	Royal Observatory.
Havana	Astronomer Royal, Royal Observatory.
Hong-Kong	Observatorio Meteorologico del Institut Nacional de Guatemala.
Indore	Nord Deutsche Seewarte.
Iowa, U. S.	Real Collegio de Belen.
Jeypore	Observatory.
Jubbulpore	Agent to the Governor General for Central India in charge of the Residency.
Katmandu	Iowa Weather Service.
Khandwa	Maharajah's Observatory.
Kitzingen, Bavaria	Civil Surgeon of Jubbulpore.
Kurrachee	Resident at Nepal.
	Civil Surgeon of Nimar.
	Dr. Emil Von Schlagintweit.
	Conservator of Forests, Bombay, Sind Division.
	Secretary to the Government of the Punjab.
Lahore	Meteorological Reporter ditto ditto.
	Sanitary Commissioner ditto ditto.
	Conservator of Forests ditto ditto.
	Editor of the <i>Indian Public Opinion</i> .
Lisbon	Observatoire de Infante d'Luiz.
	Academy of Sciences.
	Meteorological Council.
	Royal Society.
	Royal Asiatic Society (through H.M.'s Secretary of State for India).
	Society of Arts.
	Institution of Civil Engineers.
	Royal School of Mines.
	Royal Meteorological Society.
London	Admiralty Library.
	United Service Museum.
	British Museum (through H. M.'s Secretary of State for India).
	Editor of the <i>Philosophical Magazine</i> .
	Ditto <i>Athenæum</i> .
	Ditto <i>Nature</i> .
	Ditto <i>Symon's Monthly Meteorological Magazine</i> .
	Ditto <i>Westminster Review</i> .
	Ditto <i>Quarterly Review</i> .
	Secretary to the Government of Madras.
Madras	Ditto ditto Public Works Department.
	Meteorological Reporter to the Government of Madras.
	Government Astronomer, Madras.
	Sanitary Commissioner, Government of Madras.

List of Recipients of the Publications of the Meteorological Office—continued.

		Madras University.
		Editor of the <i>Madras Times</i> .
		Ditto <i>Madras Athenæum</i> .
		Ditto <i>Madras Mail</i> .
Madras		Superintendent, Government Central Museum.
		The Agricultural Reporter, Government of Madras, Saidapet.
		Surgeon General, British Medical Department.
		Ditto Indian Medical Department.
		Master Attendant of Madras.
		Conservator of Forests, Northern Circle.
Madrid		Royal Observatory.
Magdeburgh		Principal of the Observatory of the Magdeburgh Zeitung.
Manchester		Literary and Philosophical Society.
Manila		Meteorological Observatory.
Mauritius		Meteorological Society.
Melbourne, Victoria		The Observatory.
		University Library.
		Public Library.
Mexico		Central Meteorological Observatory.
Milan		Royal Astronomical Observatory.
		Royal Observatory.
Munich		Royal Bavarian Academy of Sciences.
		Geographical Society.
		The Publishers of the <i>Deutsche Rundschau für Geographie und Statistik</i> .
		Chief Commissioner, Central Provinces.
		Sanitary Commissioner Ditto.
Nagpur		Inspector General of Education, Central Provinces.
		Superintendent, Meteorological Observatory.
		Conservator of Forests, Central Provinces.
Naini Tal		Ditto ditto North-Western Provinces and Oudh .
New Haven, Connecticut		Connecticut Academy of Arts and Sciences.
		Editors of the <i>American Journal of Science</i> .
New York, U. S.		Central Park Observatory.
Nowgong-Rajshahye		Sub-Divisional Officer.
Ootacamund		Conservator of Forests, Government of Madras.
		Editor of the <i>South of India Observer</i> .
Oxford		Radcliffe Library.
		Radcliffe Observatory.
		Observatoire Physique Central de Montsouris.
Paris		Editor of <i>La Nature</i> .
		Physical Observatory, Meudon.
		Bureau Central Météorologique.
		Meteorological Society of France.
Perpignan, France		Commission Météorol. des Pyrénées Orientales.
Perth, W. Australia		Surveyor General.
Pesaro, Italy		Royal Observatory.
Philadelphia		Franklin Institute.
Poona		Conservator of Forests, Bombay, Northern Division.
Praha Bohemia		Observatory.
		Civil Surgeon of Raipur.
		Chief Commissioner, British Burma.
		Sanitary Commissioner, ditto.
		Conservator of Forests, ditto.
		Editor of the <i>Rangoon Times</i> .
Rome		Meteorological Office (Ministry of Agriculture).

List of Recipients of the Publications of the Meteorological Office—concluded.

Rio de Janeiro	Imperial Observatory.
Shaharunpore	Superintendent, Botanic Gardens.
Secunderabad	Secretary to the Resident at Hyderabad.
Shillong	{ Chief Commissioner of Assam.
	{ Deputy Conservator of Forests, Assam.
Simla	Assistant Quarter-Master General, Intelligence Branch.
Singapore	Principal Civil Medical Officer, Straits Settlements.
Stockholm	Nautisk Meteorologiska Byran.
St. Petersburg	{ Observatoire Physique Central.
	{ Geographical Society of Russia.
Strasburg	Imperial University Library.
Stonyhurst	Stonyhurst College Observatory.
Sydney	{ Observatory.
	{ University Library.
Syracuse, Sicily	Royal Meteorological Observatory.
Tasmania	Royal Society.
Tiflis, Russia	Physical Observatory.
Tokei, Japan	{ Imperial Mining Office.
	{ Imperial Meteorological Observatory.
Toronto, Canada	Magnetical and Meteorological Observatory.
Turin	Royal Astronomical Observatory.
Upsala	Meteorological Observatory.
Utrecht	Royal Dutch Meteorological Institute.
	{ K. K. Central-Anstalt für Meteorologie und Erdmagnetismus
Vienna	{ K. K. Geologische Reichsanstalt.
	{ Imperial Academy of Sciences.
	{ Dr. J. Hann.
Vizagapatam	A. V. Nursingrow, Esquire.
	{ Chief Signal Officer, United States Army.
	{ Smithsonian Institution.
Washington, U. S. . . .	{ Naval Observatory.
	{ Hydrographic Office.
	{ Professor Cleveland Abbe, Signal Office.
	{ United States' Geological Survey.
Wellington, New Zealand	Observatory.
Woolwich	Royal Artillery Library.
Zi-ka-wei, Shanghai	Magnetical and Meteorological Observatory.
Zurich	Central Meteorological Institute.

APPENDIX M.

Presentations to the Library from the 1st April 1883 to the 31st March 1884.

Place.	Donors.	Title of Work.
ADELAIDE . . .	Meteorological Observatory . . .	Meteorological observations made at the Adelaide Observatory during the year 1880.
		Bulletin Météorologique du Gouvernement général de l'Algérie; from 1st March 1883 to 16th January 1884.
ALGIERS . . .	Meteorological Service . . .	Résumé climatologique, June to September 1882.
		Tableau récapitulatif des quantités de pluie tombées quotidiennement; June to September 1882.
		Observations météorologiques du Réseau Africain, Année 1880; stations Algériennes.
ALLAHABAD . . .	Meteorological Office . . .	Administration Report of the Meteorological Reporter to the Government of the North-Western Provinces and Oudh for the year 1882-83.
		Sketch of the Meteorology of the year 1882 in the North-Western Provinces and Oudh and Eastern Rajputana.
AMSTERDAM . . .	Royal Academy of Sciences . . .	Processen Verbaal, 1881-82.
		Jaarboek, 1881.
		Verslagen en Mededeelingen. Afd Natuurkunde. Tweede Reeks, Deel XVII.
BATAVIA . . .	Magnetical and Meteorological Observatory.	Rainfall in the East Indian Archipelago, 1882 (fourth year).
		Der Südlichste Gletscher Europa's.
		Kurze Anleitung zur Anstellung der einfachsten klimatologischen Beobachtungen.
BERLIN . . .	Royal Prussian Statistical Bureau.	Klima des Brocken.
		Ueber den jährlichen Gang der Temperatur in Norddeutschland.
		Zur Leistungsfähigkeit des compensirten Magnetometers Weber Kohlrausch.
	Royal Meteorological Institute . . .	Preussische Statistik LXXI: Ergebnisse der meteorologischen Beobachtungen im Jahre 1882.
BRUSSELS . . .	Royal Academy of Sciences . . .	Bulletins de l'Académie Royal des sciences des lettres et des Beaux-arts de Belgique, 3me série, Tomes I to V.
		Annuaire 1882 et 1883.
		Bombay Gazetteer, Vols. VII, XI, XII (Parts I and II), XIV, XV (Parts I and II), and XVI.
BOMBAY . . .	Government of Bombay . . .	Nineteenth Annual Report of the Sanitary Commissioner to the Government of Bombay for 1882.
		Report on the Enteric Fever.
	Meteorological Office . . .	Brief Sketch of the Meteorology of the Bombay Presidency in 1882.
	Comptroller General . . .	Civil Estimates for 1883-84.
		Civil Account Code, Volume I, 3rd edition.
	Geological Survey of India . . .	Records of the Geological Survey of India, Volume XVI, Parts II, III, and IV, and Volume XVII, Part I.
		Memoirs of the Geological Survey of India, Volumes XII, XIX (Part IV) and XX (Parts I and II).
CALCUTTA . . .	Government of Bengal . . .	Report on the external trade of Bengal with Nepal, Sikkim, and Bhutan, for the year 1882-83.
		Returns of the rail-borne traffic of Bengal, during the quarters ending 30th June and 30th September 1883.
		Report on the internal trade of Bengal for 1882-83.
	Government of India, Home Department.	Daily Bulletin of Synopses, Indications, and Facts for September to December 1877, issued by the Chief Signal Office, Washington.

Presentations to the Library from the 1st April 1883 to the 31st March 1884—continued.

Place.	Donors.	Title of Work.
CALCUTTA— <i>contd.</i>	Government of India, Home Department— <i>contd.</i>	Rain and dry winds computed for different geographical districts, corrected to 1st January 1880 and 1st January 1881; issued by the Chief Signal Office, Washington.
		Suggestions as to the practical uses of meteorological reports and weather, maps; issued by the Chief Signal Office, Washington.
		Instructions for the management of self-recording meteorological instruments at the office of the Chief Signal Office, United States, America; issued by the Chief Signal Office, Washington.
		Instructions for taking and recording meteorological observations and for preserving and repairing instruments; issued by the Chief Signal Office, Washington.
		The influence of forests upon rainfall and inundations, being an extract from a work entitled "Etudes sur les Inondations," issued by the Chief Signal Office, Washington.
		Chronometer rates as affected by change of temperature and other causes; issued by the Chief Signal Office, Washington.
		Instructions concerning meteorological observations; issued by the Chief Signal Office, Washington.
		List of publications and maps relating to Forest Administration in India, sent to the Edinburgh International Forestry Exhibition of 1884.
		Codes of the Financial Department, sixth edition, 1884.
		Statistics of the British-born subjects recorded at the Census of India, 17th February 1881.
		Statistics of the population enumerated in the Andamans, 17th February 1881.
		Report on measurements of the growth of Australian trees on the Nilgiris.
		Report of the Census of the Punjab taken on the 17th February 1881, Vols. I to III.
		Report of the Census of Assam for 1881.
	Government of India, Revenue and Agricultural Department.	Note on Census operations in Central India and statements showing population, &c., 1882.
		Census of North-Western Provinces and Oudh in 1881, sex statistics.
		Census of the Central Provinces, 1881, Vols. I and II.
		Operations and results of the Census of 1881 in the Presidency of Bombay, including Sind.
		Report of the Census of the Baroda Territories 1881.
		Tables to accompany the rainfall map of the North-Western Provinces and Oudh, 1883.
		Administration Report upon the Madras Observatory for 1882.
		Operations and results of the Imperial Census of 1881 in the Presidency of Madras, Vols. I to V.
		Report of the Census of Bengal, 1881, Vols. I to III.
		The Indian Empire Census of 1881, statistics of population, Vol. II.
		Report on the condition and proceedings of the Government Observatory, Colaba, for the year which ended with the 30th June 1883.
		Suggestions regarding Forest Administration in the Hyderabad Assigned Districts.
	Inspector General of Forests with the Government of India.	Suggestions regarding Forest Administration in the Central Provinces.
		Review of the Forest Administration in the several Provinces under the Government of India, for the year 1881-82.
	Sanitary Commissioner with the Government of India.	Nineteenth Annual Report of the Sanitary Commissioner with the Government of India for 1882.
	S. R. Elson, Esquire	The Sandheads Sailing Directory.
	St. Xavier's College Observatory	Meteorological observations recorded at the St. Xavier's College Observatory from January to December 1883.

Presentations to the Library from the 1st April 1883 to the 31st March 1884—continued.

Place.	Donors.	Title of Work.
CALCUTTA— <i>contd.</i>	Surveyor General of India . .	General Report on the operations of the Survey of India during 1881-82.
CAPE OF GOOD HOPE	Meteorological Commission . .	Report of the Meteorological Commission for the year 1882.
CAPODIMONTE . .	A. Nobile	Terza determinazione della latitudine geographica del R. osservatorio di Capodimonte.
CHEMNITZ . . .	Royal Meteorological Institute . .	Jahrbuch des Königl Sachs Meteorologischen Instituts, 1883. Erste Lieferung.
CHRISTIANIA . .	Professor Mohn	The Norwegian North Atlantic Expedition, 1876-1878 (Meteorology).
	Royal University of Norway . .	Jahrbuch des Norwegischen meteorologischen Instituts 1877 to 1880. Etudes sur les mouvements de l'atmosphère, deuxième partie.
COLOMBO . . .	Surveyor General of Ceylon . .	The Meteorology of Ceylon in 1881.
COPENHAGEN . .	Institut Météorologique Danois . .	Bulletin Météorologique du Nord, February 1883 to January 1884.
	Royal Danish Academy of Sciences	Annuaire Météorologique pour l'année 1881.
CORDOBA . . .	Meteorological Office	Oversigt, No. 3 of 1882 and Nos. 1 and 2 of 1883.
DEHRA DUN . . .	The Editors	Annales de la oficina meteorologica Argentina, Tomo III.
	Trigonometrical Survey of India	The Indian Forester, Volume X, Nos. 1 to 3.
GREENWICH . . .	Royal Observatory	Synopsis of the results of the operations of the Great Trigonometrical Survey of India, Vols. XIV to XVI.
GUILFORD (SURREY).	A. H. Swinton, Esq.	Account of the operations of the Great Trigonometrical Survey of India, Vols. I and IX.
HAMBURGH . . .	Deutsche Seewarte	Greenwich magnetical and meteorological observations, 1881.
		Data obtained from solar physics and earthquake commotions applied to elucidate locust multiplication and migration.
HONGKONG . . .	Government of Hongkong . .	Monatliche Uebersicht der Witterung, September 1882 to August 1883 and year 1882.
		Wetterbericht, Nos. 32 to 365 of 1883 and Nos. 1 to 60 of 1884.
IOWA	Weather Service	Meteorological observations recorded at Hongkong from February to December 1883.
KARLSRUHE . . .	Baden Meteorological Observatory.	Meteorological observations recorded at stations in the colony of Hongkong for 1st to 14th December 1883.
KEW	G. M. Whipple, Esq., B.Sc. . .	First and Second Annual Reports for 1876 and 1877.
	Kew Committee of the Royal Society.	XIV Jahresbericht der Grossherz-Badischen meteorologischen Centralstation Karlsruhe für das Jahre, 1882.
	Balfour Stewart, Esq.	Composite portraiture adapted to the reduction of meteorological and other similar observations.
	G. J. Symons, Esq.	Report of the Kew Committee for the year ending 31st October 1883.
	Hon'ble Ralph Abercrombie, F.M.S., and William Marriott, F.M.S.	Terrestrial Magnetism.
	Institution of Civil Engineers . .	Symons's Monthly Meteorological Magazine, March 1883 to February 1884.
LONDON	Meteorological Society	Popular Weather Prognostics.
		The Introduction of Irrigation into new countries as illustrated in North-Eastern Colorado.....O'Meara.
	Meteorological Office	Discharge of streams in relation to rainfall in New South Wales.
		Quarterly Journal, Vol. IX, Nos. 45 to 48.
		The Meteorological Record, Nos. 8 to 10.
		Instructions for the observation of phenological phenomena.
		Weekly weather report, Vol. VI, Nos. 9 to 52.
		Report of the Meteorological Council to the Royal Society for the year ending 31st March 1882.
		Weather Reports, 1st January to 30th June 1882; 1st July to 31st December 1882; 1st January to 30th June 1883.

Presentations to the Library from the 1st April 1883 to the 31st March 1884—continued.

Place.	Donors.	Title of Work.
LONDON— <i>contd.</i>	Meteorological Office— <i>contd.</i>	The Quarterly weather report, Part II, April to June 1876, 1877, 1879, 1880, Appendices and Plates.
		Hourly readings from the self-recording instruments at the seven observatories, Parts I to IV, January to December 1881; Part I, January to March 1882.
		Rainfall tables of the British Isles for 1866 to 1880.
		Note on the Report on the Meteorology of Kerguelen Island, published by the Meteorological Council, 1879.
		Meteorologische Beobachtungen, angestellt auf Schiffen der Russischen Flotte, Band I.
		Meteorological Atlas of the British Isles.
		Sunshine records of the United Kingdom for 1881.
		Report of the second meeting of the International Meteorological Committee held at Copenhagen, August 1882.
	Royal Asiatic Society	Journal, Vol. XV, Parts I to IV.
	Royal Society	Proceedings Nos. 222 to 226.
MAGDEBURG . . .	Society of Arts	Journal Nos. 1582 to 1633.
		Report by the Committee on Solar Physics.
MAGDEBURG . . .	Solar Physics Committee	Report by the Committee on Solar Physics.
		Note on a proposed scheme for observation of the upper clouds.
MAGDEBURG . . .	W. Clement Ley	Note on a proposed scheme for observation of the upper clouds.
		Jahrbuch der Meteorologischen Beobachtungen der Wetterwarte der Magdeburgischen Zeitung Station 1er Ordnung, Jahrg I (1881 und 1882).
MANCHESTER . . .	Rev. F. W. Stow, M.A., F.M.S.	Comparative observations of solar radiation.
		Solar radiation. An account of some experiments made at Herpenden, Herts.
		Solar radiation, 1869 to 1874.
MANILA	Observatorio Meteorologico del Ateneo Municipal de Manila	Absorption of the sun's heat-rays by the vapour of the atmosphere.
		Observaciones verificadas, October to December 1879, and also for 1880, 1881, and 1882.
MELBOURNE . . .	Government Observatory	Monthly record of results of observations in Meteorology, Terrestrial Magnetism, &c., taken at the Melbourne observatory from March 1882 to November 1883.
MEUDON (Paris) . .	Physical Observatory	Annuaire du Bureau des Longitudes, 1884.
MEXICO	Central Meteorological Observatory	Anales del ministerio de Fomento de la Mexicana, Tomo VII.
		Boletin del ministerio de Fomento, Tomo VIII, Nos. 8 to 156.
		Revista mensual climatologica, Tomo I, No. 15; Tomo II, Nos. 1 and 2.
MILAN	R. Osservatorio di Brera in Milano	Anuario, Ano de 1884 (Ano IV).
		Osservazioni meteorologiche orarie ottenute da strumento registratori durante l'anno, 1881.
MONTSOURIS (Paris) .	Sui temporali osservati nell'Italia superiore durante l'anno, 1878.	Sui temporali osservati nell'Italia superiore durante l'anno, 1878.
		Annuaire pour l'an 1883.
MUNICH	Geographical Society	Annuaire pour l'an 1883.
	Ludwig Radlkofer	Jahresberichte, 1875 to 1881.
	The Publishers	Ueber die Methoden in der botanischen Systematik, insbesondere die anatomische Methode.
		Deutsche Rundschau für Geographie und Statistik, V Jahrg Nos. 7-12, VI Jahrg Nos. 1-6.
	Royal Academy of Sciences	Sitzungsberichte der Mathematische Physikalischen Classe 1881, Heft IV; 1882, Hefte I to V; 1883, Hefte I and II.
MUNICH	Royal Observatory	Gedächtnissrede auf Otto Hesse.
		Abhandlungen der mathematische, physikalischen Classe, Band XIV. Abth II, III.
		Meteorologische und Magnetische Beobachtungen, Jahrgänge, 1881, 1882.

Presentations to the Library from the 1st April 1883 to the 31st March 1884—continued.

Place.	Donors.	Title of Work.
MAURITIUS	Meteorological Society of Mauritius	Mauritius meteorological results for 1876.
MADRAS	Government of Madras	Manuals of the Salem district, Vols. I and II, and Kistna and Tanjore districts.
	Meteorological Office	Administration Report of the Meteorological Superintendent of the Government of Madras for 1882-83.
NAGPUR	Chief Commissioner, Central Provinces.	Report on the model farm in the Central Provinces for the year 1882-83.
		Report on the trade and resources of the Central Provinces for the year 1882-83.
NEW YORK	Meteorological Observatory	Abstract of registers from self-recording instruments, December 1882 to November 1883.
PARIS	Bureau Central Météorologique de France.	Bulletin International, Vol. XXVII, Nos. 61 to 365; Vol. XXVIII, Nos. 1 to 52.
		Annales du Bureau Central Météorologique de France, 1877; 1879, Tomes II and III; 1880, Tomes I and IV.
	Société Météorologique de France	Annuaire de la Société Météorologique de France, 1880, 4th Trimestre; 1881, 1st and 2nd Trimestre; 1882, January, February, and May to November; 1883, January to September.
PHILADELPHIA	Franklin Institute.	Journal, March 1883 to February 1884.
PRAG	K. K. Sternwarte	Astronomische magnetische und meteorologische Beobachtungen im Jahre, 1882.
RIO DI JANEIRO	Imperial Observatory	Bulletin Astronomique et météorologique, January to October 1883.
		Annales de l'Observatoire Impérial de Rio de Janeiro, Tome I: description de l'Observatoire.
SINGAPORE	Principal Civil Medical Officer, Straits Settlements,	Annual Medical Report on the Civil Hospitals in the Straits Settlements for the year 1882.
		Straits Settlements meteorological returns for 1882.
STONYHURST	Stonyhurst College Observatory	Results of meteorological and magnetical observations, 1860, 1862, 1865 to 1870, and 1872 to 1882.
STOCKHOLM	Avee Panches	Sur la variation diurne de la force du vent par H. E. Hamburgh.
ST. PETERSBURG	International Polar Commission	Communications from the International Polar Commission, Part IV.
	Physical Central Observatory	Annalen des physicalischen Central Observatoriums, Jahrg. 1881, Theil II.
		Results of rain and river observations made in New South Wales during 1882.
		Results of meteorological observations made in New South Wales during 1875.
SYDNEY	Government Observatory	The Sydney Observatory, its history and progress.
		Anniversary address delivered to the Royal Society of New South Wales on the 3rd May 1882, by H. C. Russell, B.A., F.R.A.S., &c.
		The spectrum and appearance of the recent comet, H. C. Russell.
SYRACUSE	Osservatorio Centrale di Siracusa	Osservazioni meteorologiche, Anno VII, Nos. 1 to 12.
TASMANIA	Royal Society	Papers and proceedings of the Royal Society of Tasmania for 1882.
TIFLIS	Physical Observatory	Magnetische Beobachtungen des Tifischer physicalischen Observatoriums im Jahre 1882.
TOKIO	Imperial Meteorological Observatory.	Meteorological observations recorded at Ozaka, Hiroshima, Nügata, and Nagasaki for July to December 1882; at Kochi, April, and August to December 1882; at Kanazawa, March, April, and September to December 1882; at Tokio, June to October 1882.
	University of Tokio	Measurement of the force of gravity at Sappro (Vesso), being an Appendix to Memoir No. 5 of the Science Department.
TORONTO	Meteorological Office, Canada	Report of the Meteorological Service of the dominion of Canada for 1881.
		Monthly Weather Review, February 1883 to January 1884.
		General Meteorological Register for the year 1883.
TURIN	R. Osservatorio Astronomico di Torino.	Bolletino dell'osservatorio della regia Università di Torino (Parte meteorologica) Anno XVII (1882).

Presentations to the Library from the 1st April 1883 to the 31st March 1884—continued.

Place.	Donors.	Title of Work.
UPSALA . . .	Meteorological Observatory . . . Mons. A. G. Hogbom . . . Dr. J. Hann . . . Dr. Josef M. Pernter . . . K. K. Central Anstalt für Meteorologie und Erdmagnetismus. K. K. Geologische Reichsanstalt	Bulletin Mensuel, Vol. XIV, Année 1882. Sur la trombe du 7 Juin 1882 dans la vallée de Säby. Samlung of bemärkelsedagar tecken, marken, ordsprak och Strock ror ande vaderleken. Sur la distribution des Eléments météorologiques autour des minima et des maxima barométriques. Marche des isothermes en automne dans le Nord d'Europe. Zeitschrift der oesterr. Meteor. Gesellschaft Band XVIII, April to December 1883; Band XIX, January to March 1884; Index for 1883. Bericht über die Fortschritte der geographischen Meteorologie. Psychrometerstudie. Jahrbuch, neue Folge, XVI Band, Jahrg 1879; XVII Band, Jahrg 1880; XVIII Band, Jahrg 1881. Erster Theil. Telegraphischer Wetterbericht, Jahrg VII, Nos. 60-355, and VIII, Nos. 1 to 41. Verhandlungen No. 5 of 1881; Nos. 12 to 18 of 1882; Nos. 1 to 9 of 1883.
		<i>Ginzel.</i> —Astronomische Untersuchungen über Finsternisse.
		<i>Freih v. Haerdt.</i> —Bahnbestimmung des Planeten "Adria."
		<i>Hammerl.</i> —Über Regenbogen, gebildet durch Flüssigkeiten von verschiedenen Brechungsexponenten. Studie über das Kupfervoltameter.
		<i>Happerger.</i> —Bahnbestimmung des Kometen 1874, III (Coggia).
		<i>Holetschek.</i> —Über die Bahn des Planeten 111 Até II Theil.
		<i>Gruss und Kogler.</i> —Über die Bahn der Oenone 215.
		<i>Tschermak.</i> —Über die Meteoriten von Mocs.
		<i>Tranz Wähner.</i> —Das Erdbeben von Agram am 9th November 1880.
		<i>Oppolzer.</i> —Beitrag zur Ermittlung der Reduction auf den unendlichkleinen Schwingsbogen: Note über eine von Archilochos erwähnte Sonnenfinsterniss.
		<i>Norbert Herz.</i> —Zur Theorie der Bahnbestimmung eines Kometen: Über die Möglichkeit einer mehrfachen Bahnbestimmung aus drei geocentrischen Beobachtungen.
		<i>Heinrich Krents.</i> —Über die Bahn des Kometen von 1771.
		<i>Karl Telbr.</i> —Über die Bahn der Kometarischen Nebelmasse Schmidt, 1882.
		<i>Hobtschek.</i> —Bahnbestimmung des vierten Kometen vom Jahre, 1874
		<i>Stefan Wolynciewicz.</i> —Bahnbestimmung des Planeten 210 "Isabella.
		<i>Richard Canaval.</i> —Das Erdbeben von Gmünd am 5 November 1881.
		<i>Ferdinand Antow.</i> —Bestimmung der Bahn des Planeten 114 Cassandra.
		<i>Tulner Preston.</i> —Eine dynamische Erklärung der Gravitation: Über die Möglichkeit, vergangene Wechsel im Universum durch die Wirkung der jetzt thätigen Naturgesetze auch in Übereinstimmung mit der Existenz eines Wärmegleichgewichtes in vergrößertem Masstabe zu erklären.
VIENNA	Royal Academy of Sciences	<i>Mach.</i> —Versuche und Bemerkungen über das Blitzableitersystem des Herrn Melsenens.
		<i>Pernter.</i> —Psychrometerstudie.
		<i>Schawars.</i> —Astronomische Untersuchung über eine von Archilochus und eine in einer assyrischen Inschrift erwähnte Sonnenfinsterniss.
		<i>Leisnar.</i> —Zur Theorie des Lamontschen Variations. Apparates für Horizontal Intensität.
		<i>Gerst.</i> —Methode zur Bahnbestimmung aus drei vollständigen Beobachtungen.

Presentations to the Library from the 1st April 1883 to the 31st March 1884—concluded.

Place.	Donors.	Title of Work.
VIENNA— <i>contd.</i>	Royal Academy of Sciences.	<p><i>Wolfbaner</i>.—Die chemische Zusammensetzung des Wassers der Donau von Wien im Jahre 1878.</p> <p><i>Foullon</i>.—Über die mineralogische und chemische Zusammensetzung des am 16th February 1883, bei Alfanello gefallenen Meteorsteines.</p> <p><i>Tschermak</i>.—Beitrag zur Classification der Meteoriten.</p> <p><i>Hann</i>.—Über die Klimatischen Verhältnisse von Bosnien und der Herzegowina.</p> <p><i>Neissl</i>.—Bahnbestimmung des grossen Meteores vom 13, März 1883.</p> <p><i>Norbert Herz und Issef Strobel</i>.—Reduction des Anwer'schen Fundamental Cataloges auf die Leverrier'schen Praecessionscoefficienten.</p> <p><i>Ferdinand Antow</i>.—Definitive Bahnbestimmung und Ephemeriden für den Planaten 154 Bertha.</p> <p>Anzeiger. Nos. XVII to XXVIII of 1882; Nos. I to XXI of 1883.</p>
VIZAGAPATAM	A. V. Nursingrow, Esq.	Results of Meteorological observations made at G. V. Juggarow's Observatory, Vizagapatam, during 1881 and 1882.
WASHINGTON	Chief Signal Office	<p>Bulletin of International Meteorological Observations, 1st September to 31st December 1880.</p> <p>Monthly Weather Review, December 1882 and January 1883.</p> <p>Annual Report of the Chief Signal Office for the year 1880.</p> <p>Bulletin of International Meteorology for August 1882.</p>
	United States Geological Survey	A new method of measuring heights by means of the barometer, by G. K. Gilbert.
	United States Naval Observatory	Meteorological observations made at the United States Naval Observatory during 1878 and 1879.
	Meteorological Observatory	<p>Abstract of meteorological observations, New Zealand, for the quarters ending September and December 1882, and March, June, and September 1883.</p> <p>Statistics of New Zealand (meteorology), 1878 to 1882.</p> <p>Meteorological observations, Wellington, March and April 1883.</p>
WINDSOR (N. S. WALES).	John Tebbutt, Esq.	Results of meteorological observations made at the private observatory of J. Tebbutt at Windsor (New South Wales) in 1877-81.
ZI-KA-WEI.	Magnetical and Meteorological Observatory.	<p>Meteorological observations recorded at Zi-ka-wei, October 1882 to June 1883.</p> <p>Variations de l'aiguille aimantée pendant les Eclipses de lune. Régime des vents à Zi-ka-wei, 1877 to 1882.</p>
ZURICH	Swiss Meteorological Institute	Meteorologische Beobachtungen an 16 stationen der Sweiz, January to December 1883.

Purchases for the Library.

- Airy's Algebraical and Numerical Theory of errors of observations and the combination of observations.
- American Journal of Science, March 1883 to February 1884.
- Annalen der Physik und Chemie, Nos. 4 to 12 of 1883; Nos. 1 to 3 of 1884.
- Barlow's Tables of squares, cubes, square roots, cube roots, and reciprocals of all numbers up to 10,000.
- Brown's mechanical movements.
- Comptes Rendus de l'Académie des Sciences, Tome XC, No. 2; Tome XCVI, Nos. 10 to 26; Tome XCVII, Nos. 1 to 27; Tome XCVIII, Nos. 1 to 8; Tables for Tomes XCV and XCVI.
- Die Geometrischen Instrumente der gesammten praktischen Geometrie, deren Theorie Beschreibung und Gebrauch.
- Elementary Meteorology: Scott.
- Encyclopædia Britannica, volumes X to XV.
- La Nature, Nos. 467, 469, 494, 503 and 511 to 562.
- Merriman's Method of Least Squares.
- "Nature," Nos. 662, 681, 686, 687 and 698 to 749.
- Philosophical Magazine for March 1883 to February 1884.
- Report of the British Association for the advancement of science for 1878 and 1882.

REPORT
ON
THE ADMINISTRATION
OF THE
METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA
IN
1884-85.

IN the Administration Report of the Meteorological Department for the year 1879-80, I gave a general summary of its work during the five years that had elapsed since its formation. The theme of this retrospect was mainly the re-organisation of the department, the measures taken to reform the pre-existing machinery of observation, to extend and complete it where most defective, and to render the results reducible to common standards; admitting, therefore, of their being compared with each other, whether relating to the same or any future or past year. The utilization of the information thus obtained, the publication of the current weather statistics, the endeavour to interpret these statistics by the light of general physical laws, and to apply the resulting knowledge to the prevision of the weather, had scarcely acquired the relative importance which it has since attained, and which is increasing in each successive year.

Another five years have now passed by, and I shall preface my report on the administration of the department for the year 1884-85, with a general review of the progress achieved in this, the second lustrum of its existence. In a slightly modified form, this review has already been submitted to the Right Hon'ble the Secretary of State, somewhat in anticipation of the completion of the full period.

GENERAL REVIEW OF THE OPERATIONS OF THE FIVE YEARS 1880-85.

The work of the department naturally falls into two divisions,—that of observation, and that of discussion and publication; the first dealing with the collection of the raw material of science, the second with its elaboration and its application to useful ends. It will be convenient, therefore, in giving an account of the progress of the last five years, to observe this order of treatment. Under the first heading I shall include not

only meteorological observation, strictly so called, but also such other registration of physical phenomena as has been carried on by the observational staff of the department.

1.—OBSERVATORIES AND REGISTRATION OF PHYSICAL PHENOMENA.

(a) *Observatories*.—According to the purpose they are especially intended to subserve, the existing observatories may be classified as—

Low-level observatories in India.
Hill observatories " "
Himalayan valley observatories.
Extra-Indian observatories.
Ships.

Of the first four classes, there were 117 observatories in 1880. There are now 128, contributing registers to the central or local offices, exclusive of 22 observatories in Bengal, which have been established in connection with the provincial system of telegraphic weather report. In respect of the kind and amount of work, they are of four classes, *viz.*—

1st class observatories, provided with instruments registering autographically. Of these there are now three completely equipped, *viz.*, Calcutta, Bombay, and the Maharaja's observatory at Jeypore. A fourth will be established at Allahabad as soon as the building now in hand is completed, and a fifth, at Lahore, when the requisite instruments shall have been obtained from America. Jeypore is the only addition made to this class during the last five years.

2nd class observatories; at which, either hourly observations are made on four days in each month, or six-hourly observations daily. They are 26 in number; five more than in 1880; and, of these, 15 are furnished with instruments for the autographic registration of the wind direction and movement.

3rd. class observatories, at which observations of the barometer, thermometer, wind, &c., are recorded twice daily, and maximum and minimum thermometers, rainfall, &c., once. Of these there are 95. There were 91 in 1880.

4th class observatories, at which only temperature, wind direction and rainfall are registered. These are 5 in number; 2 more than in 1880.

Of the whole number of 128 observatories, 12 are attached to various public offices, and independent of the department, and 6 are either private or foreign. The number of paid observatories under the department is 111. The following is a complete list, showing the classes to which they respectively belong:—

<i>Bengal and Assam.</i>					
	Class.		Class.		Class.
	2nd.	Purneah,	3rd.	False Point,	3rd.
	"	Durbhunga,	"	Calcutta (Alipore),	1st.
re (Patna),	"	Gya,	"	Do. (Chowringhee)	4th.
agh,	"	Berhampore,	"	Demagiri,	"
island,	"	Burdwan,	"	Mongpoo,	"
	"	Jessore,	"	Tura,	"
ng,	"	Dacca,	"	Pedong,	3rd
ig,	3rd.	Silchar,	"		

North-Western Provinces and Oudh.

	Class.		Class.		Class.
Allahabad,	2nd.	Mussooree (Surveyor Gen-		Gorakhpur,	3rd.
Agra,	"	eral's Office),	3rd.	Ghazipur,	"
Lucknow,	"	Dehra (Surveyor General's		Benares,	"
Roorkee,	"	Office),	"	Jhansi,	"
Chakrata,	3rd.	Do. (Forest school),	4th.	Pithoragarh,	"
Ranikhet,	"	Bareilly,	3rd.		
Mussooree (St. Fidelis),	"	Meerut,	"		

Punjab.

Lahore,	2nd.	Murree,	3rd.	Kailang,	3rd.
Mooltan,	3rd.	Sialkot,	"	Delhi,	"
Dera Ismail Khan,	"	Ludhiana,	"	Sirsa,	"
Peshawar,	"	Chamba,	"		
Rawalpindi,	"	Simla,	"		

Central Provinces.

Nagpur,	2nd.	Hoshangabad	3rd.	Sironcha,	3rd.
Jubbulpore,	"	Seoni,	"	Raipur,	"
Pachmarhi,	"	Khandwa,	"	Sambalpur,	"
Saugor,	3rd.	Chanda,	"		

Berar.

Akola,	3rd.	Chikalda,	3rd.	Makhla,	4th.
Buldana,	"	Amraoti,	"		

Central India and Rajputana.

Jeypore,	1st.	Indore,	3rd.	Sambhar,	3rd.
Sutna,	3rd.	Mount Abu,	"	Bickaneer,	"
Nowgong,	"	Pachpadra,	"		
Neemuch,	"	Ajmere,	"		

Bombay.

Colaba (Bombay),	1st.	Jacobabad,	3rd.	Surat	3rd.
Belgaum,	2nd.	Hyderabad (Sind),	"	Malegaon,	"
Poona,	"	Bhuj,	"	Ratnagiri,	"
Deesa,	"	Rajkot,	"	Karwar,	"
Kurrachee,	"	Sholapur,	"		

Madras.

Vizagapatam,	2nd.	Cuddapah,	3rd.	Cochin,	3rd.
Bellary,	"	Madras,	"	Wellington,	"
Trichinopoly,	"	Bangalore,	"	Mercara,	"
Gopalpur,	3rd.	Negapatam,	"	Mangalore,	"
Masulipatam,	"	Salem,	"	Rajahmundry	"
Secunderabad,	"	Coimbatore,	"		
Kurnool,	"	Madura,	"		

British Burma.

Rangoon,	2nd.	Akyab,	3rd.	Toungoo,	3rd.
Bassein,	3rd.	Thyetmyo,	"	Moulmein,	"
Diamond Island,	"	Mergui,	"		

Bay Islands.

	Class.		Class.
Port Blair,	3rd.	Nancowry,	3rd.

Extra-Indian.

Class.		Class.		Class.	
Leh, 2nd.		Bushire, 3rd.		Katmandu, 3rd.	
Aden, „		Quetta, „		Amini Divi (Lakhadives), „	

The large majority of the observatories are situated on the plains or low table-lands of India. The obvious purpose of these is to furnish information of the state of the atmosphere over the length and breadth of the land. The hill observatories are those situated on the hill ridges or small plateaux, and by comparison of their registers with those of some neighbouring station at a low level, they show the variation of the atmosphere in a vertical direction. The present observatories of this class are the same as in 1880, except that the Ootacamund observatory has been relinquished, while an additional observatory has been established at Pithoragarh in Kumaon.

With one exception, the observatories in valleys in the interior of the Himalaya are of more recent date, and their object is different. There is reason to believe that, while the condition of the atmosphere over the mountain range is frequently very different from that which obtains over the plains, being cold and dense, when the latter is dry and hot, or frequently disturbed by storms while the latter is in a state of continued drought, the latter is to a considerable extent dependent on the former. It is with a view to the continued study of these relations, and also for obtaining information respecting the condition of the snows, that these Himalayan observatories have been established. They are at present three in number, *viz.*, Leh in the Indus valley, Kailang in the Chandra valley, and Chamba in that of the Ravi.

The observatories of Bushire, Aden, Zanzibar,¹ and the Seychelles have been established for the purpose of affording some information of the state of the atmosphere, more especially as regards pressure and winds at a few points, distant from India itself, but not so distant that the atmospheric conditions there prevailing may not have considerable influence on the Indian weather, and especially on the varying characters of the monsoons. The full utility of this class of observatories can hardly be brought out, until we possess a much better knowledge, than at present, of the average meteorological conditions of the North Indian Ocean. Three of the above observatories, *viz.*, Aden, Zanzibar, and the Seychelles, have been established during the past five years, and the information they afford is supplemented by that of the monthly abstracts communicated by Mr. Meldrum from the Mauritius.

(b) *Marine observation.*—The endeavour to collect information from ships by the direct agency of the department has hitherto been restricted to the Bay of Bengal. In 1881, Mr. Eliot organised a system of collecting from ships entering the port of Calcutta, copies of so much of the meteorological entries in their logs as related to their passage up the Bay of Bengal from the Equator. In the first year, 345 sets of these returns were obtained and posted in books according to their dates. In the second year the number was smaller, *viz.*, 253, but of higher quality, and as the result of the two years' experience, Mr. Eliot is of opinion that a large amount of valuable information can easily

¹ As will be recounted later on, both these observations ceased to furnish registers in 1884.

be obtained from the captains of vessels navigating the Bay, and that the majority of the officers of the mercantile marine are ready, even at considerable trouble to fill in the returns, in the hope that they may be of some use in the investigations of the Meteorological Department.

In addition to the data thus obtained from merchant vessels, regular meteorological registers are now kept on board the light vessels near the mouth of the Hooghly.

(c) *Rainfall registration*.—In 1880 there were two extensive tracts in British India, from which rainfall returns were almost entirely wanting. One of these comprised Western Rajputana, Khyrpore, and Bahawalpur, an area of about 65,000 square miles between the Aravali range and the Indus. The other, the greater part of Chutia Nagpur, South Rewah, the Gurhjat States, and the zemindaries that lie between Nagpur and the Northern Circars. The total extent of this latter region is about 150,000 square miles. Rain-gauges have now been established at 7 stations in the former, and 26 stations in the latter. A few of these were in existence in 1880, although the registers were not available in the office, but the majority have been provided within the last five years. At the present time, rainfall returns are received regularly from all parts of the empire.

It has long been an object to obtain a form of gauge suitable for collecting the rainfall in forests and places at a distance from any habitation; which, therefore, can only be visited at more or less distant intervals. Elaborate mechanical contrivances for registering the fall are but little fitted for use in a country where skilled mechanics are so rare, and it has therefore been sought to attain the object by using a capacious receiver, and by providing a separate apparatus for measuring the evaporation. This contrivance, as hitherto tried, has not been found to give very accurate results in the hot season, when rain occurs at long intervals and the evaporation is rapid, but the experiments are still being carried on, and I have little doubt that success will be achieved before long.

(d) *Actinometric observation*.—The measurement of the sun's heat has received much attention during the last five years. In November 1879, registration with a Balfour Stewart's actinometer was commenced at Alipore Observatory, and continued daily till February 1883, when the observations ceased, the instrument being required at Mussooree. The results are not without interest, and Professor G. Stokes detected in them an apparent variation, which seemed to indicate a slight increase of solar intensity, too systematic to be the result of accidental circumstances: but the experience gained showed that the skies of Calcutta are far from favourable for such work.

Meanwhile, Sergeant Rowland, of the Royal Engineers, had been appointed by the Secretary of State to proceed as actinometric observer to Leh, a station which the almost uniform testimony of residents had indicated as one presenting peculiar advantages for actinometric observation. He arrived at Bombay on the 31st October 1882, and was employed during the following eleven months at Mussooree, practising his work and verifying his instruments under the direction of Mr. J. B. N. Hennessey. He reached Leh in the beginning of November 1883, together with an European assistant, who had been trained with him; and, during the past year and a half, has registered observations according to an admirably devised scheme, drawn up by Mr. Hennessey. But the climate has proved most disappointing. Not only has the work been so frequently interrupted by cloud that, in some months, it has not been possible to register a single day's complete set of observations, but even, when unclouded, there has been a peculiar haze, indicated by

the pallor of the sky, which is almost certainly absorbent of an appreciable portion of the solar heat. Whether this is the same haze to which the brilliant afterglows and frequent coronas of the past year are due, and therefore an abnormal feature of the Leh climate, can be only a matter of speculation.

As there is some reason to believe that the year has been exceptionally unfavourable,¹ the observers will remain at Leh till October 1885. An opinion may then be formed whether the advantages presented by Leh over such a station as Mussooree are such as to justify the further retention of an observer at that station.

(e) *Sunshine Recorders*.—The registration of the duration of bright sunshine by means of the instrument originally invented by Mr. Campbell of Islay, and subsequently improved by Professor Stokes and Mr. Whipple, has been carried out at Calcutta since November 1882, at Allahabad since March 1882, and at Jeypore since January 1884, and will be shortly extended to Lahore, and some more central station, probably Nagpur. The duration of sunshine is of not less importance than its intensity, as a meteorological datum, and its registration is a most valuable addition to the records of Indian meteorology.

(f) *Records of ground temperature*.—The temperature of the ground at the surface, and at depths, varying down to 25 feet, is regularly recorded at Calcutta, Allahabad, Dehra, and Jeypore. It varies from year to year, and appears to depend partly on the amount of sunshine, the principal heating agent, partly on the cooling effect of evaporation; which again depends on the rainfall. In 1880, the only register of this kind was that of the Alipore Observatory, Calcutta. It was begun at Allahabad in May 1880, at Dehra in June 1881, and at Jeypore in August 1881.

(g) *Snowfall reports*.—Reports on the state of the Himalayan snowfall, during the winter and spring, were first received from the Commissioner of Kumaun in 1880, and occasional information has also been communicated by other officers; in 1882, at the request of the Government of India, the attention of Civil Officers residing in the Hill States was especially directed to the subject: further steps were taken to the same end in 1883; and in the winters of 1883-84 and 1884-85, and the following springs, monthly reports were regularly received from all parts of the Himalaya, in which there are resident Civil Officers, as well as much casual information collected from travellers by these officers, or communicated by non-official residents.

The importance of this information lies in the apparent connection between the Himalayan snows and the dry winds of North-Western and Western India,—a subject to which I shall return in a subsequent part of this report.

¹ In a foot-note to the Administration Report for 1882-83, I quoted from a Report of the Surveyor-General, General J. T. Walker, as follows :—"I believe from much experience of the climate, that few better places in the world can be found than Leh for any sun observation. The number of cloudy days in the year is very small. One may say that from early April to October there are almost none. The air is perfectly free from moisture, and without vapour of any kind, &c."

In conjunction with this, I may give the following extract from a letter dated 3rd November 1884, recently received from the Revd. A. W. Heyde, resident for some 30 years at Kailang in Lahoul, 10,000 feet above the sea, in which I have mentioned it already in former letters to you that, since about 12 to 15 years, the latter half of August the whole of September and October have become very unsettled as regards the weather, rain or snow occurring now, often during these months, which, as a rule, formerly was a time of fine clear weather. These untimely precipitations interfere very unpleasantly with the hay-making and harvesting in the valley now nearly every year, of which many complaints are heard. Whether this has something to do with a change of climate, which, as is said, is gradually coming over these parts, I cannot say. A similar experience is made in Ladak and other parts of the Western Himalaya. Officers who took part in the triangulation of Ladak, during four or five seasons between 1860 and 1870, say they never could have done their work, if, at that time, the sky over Ladak had always been so cloudy and the high ranges so frequently been enveloped in clouds as is now the case."

(h) *Seismic observatories*.—The registration of earthquakes has been undertaken at some observatories in Assam for the information of the Geological Survey. The apparatus, provided for the purpose by the Superintendent of the Geological Survey, has been set up at the observatories in the above province, with a view to convenient registration, and not because of any intimate connection being supposed between earthquakes and meteorology.

2.—DISCUSSION AND PUBLICATION.

The immediate object of the department, and indeed its justification in the eyes of the general public, is to disseminate trustworthy information of the current weather, and, as far as may be, to prognosticate that which may be expected to follow. It is in this direction that the chief advances have been made during the last five years.

The prevision of the weather indeed is at present *in embryo*, and must be so until the laws of weather changes are much better known than at present. But this knowledge is steadily advancing, and numerically weak as is the Indian Meteorological Department in its scientific staff, it may fairly challenge comparison with its representatives in other countries, in the importance of its contribution to the general stock. I will first notice the extensions of the weather report systems that have been effected in recent years, and will afterwards advert on the scientific work of the officers and its bearing on weather prevision.

(a) *Daily weather reports for India*.—The daily telegraphic report of the weather was started in 1878, and in 1880, reports were received from 50 stations in the fine season, and from 84 in the rains, of which 24 reported only the rainfall. During five months of the rains, the weather bulletins were issued at Simla, and were then accompanied with a short verbal description of the weather, in addition to the tabulated returns for the day. During the remainder of the year they were published in Calcutta and consisted of the tabulated data only.

In 1881 the system was extended. All observatories with which there is telegraphic communication, (at present 96 in number) now send a daily telegram of the weather throughout the year; and, in the rains, these reports are supplemented by telegrams of the rainfall only from 28 additional stations, making 124 in all. Also the information given is fuller, including the highest and lowest temperatures of the previous 24 hours, in addition to other information.

The report is issued with a descriptive summary of the state of the weather throughout the year, and this is telegraphed every afternoon to all the seats of Government and to the principal daily newspapers. A daily chart is prepared for office use, but this is not published.

(b) *Daily and weekly weather reports for Bengal*.—Two weather bulletins are issued daily from the Bengal Office from the 15th May to the 15th November, and one during the remainder of the year. That which is issued only during the south-west monsoon, gives the weather of the province as telegraphed every morning from 31 observatories, of which 22 are maintained at the cost of the Government of Bengal. A report on these is prepared daily, printed with the tabulated data at the Bengal Secretariat Press, and distributed the same afternoon, in time for the outgoing mails. This system was organised by Mr. Eliot in May 1883, and has now been in work during two seasons with great success.

The report, issued daily throughout the year, gives the weather around the coasts of the Bay of Bengal, and, inferentially that of the Bay itself, on the information reported by telegram daily from 17 stations at 10 A.M. In April 1880, the number of telegraphing stations was increased from 7 to 15, and the report was for the first time lithographed, illustrated by a rough chart, and printed in the Meteorological Office, and circulated to subscribers the same afternoon. Since then, this issue has been much improved in form, and is now equal in appearance to the average of similar publications issued by European Governments. The general improvement, effected in this report and in its expeditious publication, has been proposed and carried out by Mr. Eliot in the last five years. In addition to the above, weekly meteorological and rainfall statements are prepared and published in the *Calcutta Gazette*. The first gives the average and extreme values of all the meteorological elements for the week, at all the observatories in the province, and the second gives the daily rainfall at 166 stations. They are accompanied with a descriptive summary.

A similar, but more comprehensive, summary is drawn up and issued monthly.

Thus, a system of provincial weather report has been established in Bengal on a semi-independent basis, and is worked with great despatch, and in a most effective manner. The observatories of the imperial system are utilized as far as they go, but they have been largely added to; the weather telegrams are transmitted as urgent, and therefore have priority of despatch, and the reports relating to any day are printed and distributed on the afternoon of that day. All the additional expense incurred for the purpose is contributed by the Local Government. These improvements have been introduced and carried out by Mr. Eliot within the last two years.

(c) *Storm warnings in Calcutta and Bombay*.—A system of storm signals, for warning the port of Calcutta of cyclones approaching from the Bay, has been in operation since 1868, and was indeed the object for which the Bengal Meteorological Department was originally founded. As will presently be explained more at length, the study of these storms has always engaged much of the attention of the officers who have successively held the appointment of Meteorological Reporter to the Government of Bengal; and Mr. Eliot, especially, has contributed several valuable memoirs on them to the publications of the department. As the result of these studies, Mr. Eliot found himself enabled, in November 1881, to propose to the Government of Bengal a considerable extension of the system then existing, which had aimed merely at giving warning to Calcutta of the formation and approach of those extensive and severe storms; which are, as a rule, restricted to the periods of the changing monsoons. These occur but rarely, and in some years fail entirely; but storms of limited extent, which nevertheless are frequently very violent over a small area, are commonly formed at the head of the Bay during the rainy season, and indeed may be considered as a characteristic feature of the season. They are dangerous to shipping leaving the port of Calcutta, and it was therefore desirable to have the means of issuing special warnings to the lower reaches of the river, whenever such storms appear about the Sand Heads. The new system of signals devised by Mr. Eliot was especially adapted to give this information, and, in certain cases, to indicate the probable course the storm would take; whether to east or west of the mouth of the Hooghly.

After due consideration, the new system was approved by the Government of Bengal and its adoption was notified in the *Calcutta Gazette* on the 9th August 1882. It has since been working with excellent results.

A system of telegraphic report and storm warnings for the coasts of Bombay was established in 1880. Storms are rarer on the Bombay coast than on the Indian coast of the Bay of Bengal, and comparatively little attention has been paid to the laws of their formation and their courses. It was however known that, in some cases, storms, originating on the Bay of Bengal, cross the peninsula, and affect the ports on the west coast; and hence, in organizing a system of telegraphic weather report for warning the Bombay coasts, it was necessary to provide for due notice of storms, occurring on the east coast of India, being communicated to the Bombay Office. The scheme eventually adopted, and which has been in operation for the last five years, provides for daily weather telegrams being sent to Bombay from three stations on the Madras coast, as well as from eight on the west coast of India; and the Bombay reporter is empowered, on occasion arising, to call for urgent reports from other observatories in the interior of the country. Furthermore a special notice is telegraphed from the Meteorological Office of the Government of India, of any storm that appears in any part of India, and which seems likely in its subsequent course to affect any part of the Bombay coast. Storm signals, consisting of a cone for the day-time and three lamps in a triangle at night, are provided at Bombay and five other ports, and are hoisted on due intimation to that effect from the Bombay Office.

(d) *Flood warnings*.—This is an object, towards which, at present, some first steps only have been taken; and it remains for future experience to show how far useful warnings are practicable. The only occasion on which anything of the kind has been attempted hitherto, was one in which an irrigation officer, engaged in the construction of a weir across the Betwa river, desired to have early information of the setting-in of the monsoon rains at India. It has been recently proposed, as a consequence of the destructive floods of the Nerbudda and Tapti, to communicate to the Civil Officers and Political Officers of Surat, Baroda, &c., early notice of any unusually heavy rainfall in the drainage basins of these rivers, and a plan has been drawn out which will be brought into operation as an experiment on the approach of the next rainy season.

The floods in these rivers are usually the result of the excessive rainfall accompanying the passage of a cyclonic storm, (one of the small monsoon storms adverted to above,) which, as a general rule, originate over the head of the Bay of Bengal, and then travel westwards. As they generally take two or three days to reach Central India, it is almost always possible to send ample premonitory notice of their approach to the hilly region in which the floods originate, even if it be found impracticable to send notice of the actual rain, in time to anticipate the flood. As far as practicable, however, this last will also be attempted, but the information will be telegraphed direct from the rainfall stations to those threatened by the flood, and not sent through any Meteorological Office.

If this system be found to give useful information, it might be extended to some other rivers. Its applicability is however restricted by the consideration, that many of the large rivers rise in hilly and thinly populated districts, where neither rainfall measurements nor telegraphs are available.

(e) *Weather forecasts*.—Any successful forecast of the weather that can pretend to be more than a happy guess, fortuitously fulfilled must be the last outcome of a highly developed body of science; and nothing could be more unreasonable than to expect from a system of observation, which has not yet existed for ten years, more than a few imperfectly verified generalizations, which may perhaps hereafter be developed into the

basis of a trustworthy system of weather prognosis. Some such generalizations have indeed been elicited from the systematic study of the weather, and will presently be noticed. Actual forecasting has hitherto been attempted only, firstly, in the case of the Bengal daily weather reports, issued during the monsoon, in which the probable weather of the ensuing 24 hours is depicted briefly in the most general terms; and, secondly, in the case of the monsoon rains, with respect to which, in one or two years, an endeavour has been made to estimate the probabilities of the monsoon, from a consideration of the weather of the antecedent period. Such partial success as has attended these attempts to forecast the weather seems to testify to the general validity of the method adopted, and to justify the hope that further experience may enable them to be repeated with increased confidence.

(f) *Time Signals, Calcutta*.—Although but remotely connected with meteorological work, the working of the Time-signals may be mentioned here as part of the work of the department, undertaken for public information and guidance. The old time-ball on the Semaphore Tower in Fort William was replaced by a new ball and apparatus; (the invention of Mr. Varley,) in 1882, and a similar apparatus, set up the previous year on the Port Commissioners' Office, was worked during the removal of the old ball, and the erection of its substitute. Both balls have been dropped daily, (except on Sundays and holidays,) since May 1882. New and shorter connections have been made between them and the Alipore Observatory; and, during the last year, the time signals have been worked with a degree of regularity never before attained in Calcutta.

(g) *Publication*.—The regular publications of the office, other than the ephemeral weather reports and returns, consist of the Annual Report on the meteorology of India; the original registers, in full, of six stations in India; and the serial issue of special discussions, under the title of the *Indian Meteorological Memoirs*. The first appears yearly, the second monthly, the third at irregular intervals.

Of the memoirs, nine had been published up to 1880. The following have since appeared :—

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| VOLUME I, PART V | { | 10th.—Some results of meteorological observations at Allahabad during the 10 years 1870-79. By S. A. Hill, B.Sc. |
| | | 11th.—The diurnal variation of the barometer at Indian stations. Part II—Goalpara, Patna, and Leh. By H. F. Blanford. |
| „ VI | . | 12th.—The meteorology of the North-Western Himalaya. By S. A. Hill,—Index to Volume I. |
| „ II, „ I | { | 1st.—Account of the South-West monsoon storms of the 18th to the 24th September 1878, in the north of the Bay of Bengal. By John Eliot, M.A. |
| | | 2nd.—List of cyclones on the west coast of India, and in the Arabian Sea, up to the end of the year 1881. By F. Chambers. |
| „ II | { | 3rd.—Note on the foregoing list of cyclones and on the Guzerat land cyclone of July 11th—13th, 1881. By H. F. Blanford. |
| | | 4th.—On the temperature of North-Western India. By S. A. Hill, B.Sc. |
| „ III | . | 5th.—Account of the south-west monsoon storm of the 8th to the 19th October 1882, in the Bay of Bengal. By J. Eliot, M.A. |

Another memoir on the storms of the years 1877 to 1881, by Mr. Eliot issued since the close of the year under report, and a memoir by Mr. Hill on certain comparative hygrometric observations at 4 feet and 40 feet above the ground, now in the Press, will complete volume II, and a discussion of the rainfall of India, now well advanced towards completion, together with the rainfall tables, will probably by itself make a third volume of the memoirs.

Other publications of the office, that have been issued since 1880, are—A rainfall chart of India, on a scale of 64 miles to the inch, showing the average annual distribution of the rainfall according to locality and season; published in 1883. *Instructions to Meteorological Observers in India*, 2nd edition, enlarged and corrected. *Telegraphic Code and Instructions*, for use in the Indian Meteorological Department, 3rd edition, enlarged and revised, 1883.

(h) *General Scientific Results*.—I now come to speak of those general results which represent the solid gains of the last ten years' work, *viz.*, those advances in our general knowledge of the climatology and physical meteorology of India, which enable us, in the first place, to give some rational explanation of weather changes and the variations of the climate now in progress; and afford, in the second place, the only possible basis for a prognosis of those which are impending in the future. I do not here include mere statistics or descriptions of climate. These, indeed, are given abundantly in the regular publications of the office, and are doubtless useful for comparison with statistics of other kinds. But such are only the raw material for scientific treatment, and it is only when they are compared and examined by the light of physical laws that they lead up to any real extension of our knowledge.

Two subjects, more especially, have engaged the attention of the small scientific staff of the department, *viz.*, the mode of origin, and the progressive march of storms, and the laws which regulate the rainfall and its vicissitudes. The list of memoirs, given above, shows that one-half of those, published during the last five years, deal with the cyclones of India and its seas; and the much more comprehensive memoir of Mr. Eliot, lately issued, is devoted to the same subject. It has already been mentioned, in an earlier part of this memorandum, that as the result of the increased knowledge gained from the assiduous study of storms, a considerable extension and improvement of the storm-warning system has been carried out in Bengal; and it is this same knowledge that has enabled Mr. Eliot to give, during the rainy season, a general forecast of the weather of the day. The flood warnings which it is now proposed to issue to the districts near the mouths of the Nerbudda and Tapti rivers, and those warnings of approaching storms which, during the past two or three years, have been sent from the Central office to Bombay, generally two or three times in the season, are further fruits of the study of storm tracks.

The other subject, the rainfall and its vicissitudes, is one presenting much greater difficulties, and progress is consequently slow. Only two memoirs, *viz.*, the 5th and 7th of the 1st volume, are specially devoted to the subject of rainfall; but incidentally, it enters as a subject of discussion into several others, specially the first; and the third volume of the memoirs will be entirely devoted to it. The chart of the average rainfall of India, published in 1883, is one of the first fruits of this investigation. Certain coincidences and sequences have been observed in the very vicissitudes of the rainfall, which seem to be recurrent, and are probably capable of being generalized into laws. One of these is set forth in the 7th memoir of the 1st volume; and the other, having been frequently referred to in the annual reports, has recently been put into a definite form and published in the proceedings of the Royal Society. The first is the discovery of Messrs. Hill and Archibald, that copious winter rains in Northern India are usually followed by a deficient monsoon rainfall. The second is the apparent fact that extensive snow precipitation on

the North-West Himalaya tends to produce dry winds in North-Western and Western India; and hence, an unusually heavy and late spring snowfall causes a retarded or interrupted monsoon rainfall in those parts of India. At bottom, these appear to be statements of one and the same truth, approached from different directions. In the last two years, a forecast of the monsoon rainfall has been hazarded on this basis; and, in both instances, the results have so far justified the prognosis as very considerably to enhance my confidence in the soundness of the fundamental assumption.

The only great famine that has occurred in India, since the Meteorological Department was placed on its present basis, was the result of a prolonged drought, evidently partly induced by other conditions. These also have been placed on record, and their recurrence, at any future time, will serve as a presage of the possible recurrence of severe drought.

The question of the periodicity of rainfall variations and of other meteorological phenomena has engaged the attention of several officers of the department. In more than one case, such periodical variations, apparently coincident with the well-known sun-spot variation, have been detected; and it is possible that, to some extent, those conditions which manifest them most distinctly may influence the rainfall. But it cannot be said, at present, that this connexion rests on any stronger basis than a certain preponderance of probabilities; and, in any case, the periodical element of the rainfall variation, if real, is probably of subordinate importance, and only of local validity.

The study of the meteorology of Indian seas has been taken in hand systematically within the last three years, and will certainly become more important in the future. As yet, the work is not so far advanced as to admit of any generalizations of importance. And when the average conditions of Indian seas shall have been determined from the accumulated observations of past years, a considerable extension of the present system of marine registration will be necessary, in order that the knowledge, thus acquired, may be turned to account in throwing light on the current weather changes.

Weather charts of the Bay of Bengal, for each month of the year, are in part completed and will be lithographed and published for the use of seamen. Those showing the prevailing winds and the state of the barometer are completed in original, and they are now being copied and reduced to a convenient size for publication.

ADMINISTRATION IN 1884-85.

PART II.

INTRODUCTION.

IN the preceding pages, I have given a general summary of the progress and work of the department during the last five years. In the remarks which here follow, as prefatory to the special report on the administration of the past year, it will therefore be necessary only to add some further particulars relating to certain of the topics already noticed, and which have received more especially the attention of the scientific staff of the department in the year now under review.

ACTINOMETRIC OBSERVATIONS.—In the reports of the two previous years, I have detailed the steps taken to give effect to a recommendation of the Commissioners appointed, by the Secretary of State, to report on the famine of 1876—1877, in so far as related to the systematic registration of the solar heat with the best and most suitable instrument hitherto constructed. It has been related that Sergeant Rowland of the Royal Engineers, together with an European assistant, selected and trained at the Surveyor General's Office at Dehra and Mussooree, was sent to Leh in the autumn of 1883, and that the observers commenced their work in November of the same year on a site selected by them on arrival, as affording the best exposure for the purpose. According to the scheme of operations drawn up for their guidance by Mr. Hennessey, the observations to be recorded were of two classes, a more and a less comprehensive series of observations of the solar heat; the solar rays being concentrated, by means of a lens, on the blackened bulb of a thermometer, surrounded by a massive brass box. On all clear days, these observations were to be taken at noon, (with the sun on the meridian), and also once in the morning and once in the afternoon, with the sun at certain definite altitudes. These were the daily series.

In addition to these, on certain selected days, (from 1 to 6 in each month), similar observations were to be taken at short intervals in succession, during so many hours as the altitude of the sun should exceed a certain assigned minimum. These were termed long range series, and it was anticipated that, under the clear skies to be expected at Leh, a very large series of observations of the solar intensity would be thus recorded, on a systematic plan, at a place where unfavourable and disturbing atmospheric conditions would interfere but little with its completeness and continuity, and where the observers would be above the level of the denser and more absorbent atmospheric strata.

These hopes have been doomed to disappointment. Owing to the cloudiness of the skies, Leh has proved, during a large part of the year, even less favourable for the work, than the station of Mussooree, at which the observers were trained previously to their departure; and instead of the approximately complete series expected, the following are all that the observers have been able to obtain during the 17 months of their residence at Leh.

MONTHS.	DAILY SERIES.		LONG SERIES.	
	Complete.	Incomplete.	Complete.	Incomplete.
November 1883 . . . . .	...	1	...	...
December „	3	3	...	...
January 1884	3	2	...	1
February „	2	3	...	3
March „	1	3	...	3
April „	1	5	...	1
May „ . . . . .	...	6	...	...
June „	6	4	1	...
July „	5	2	...	1
August „	4	6	1	2
September „	8	6	2	...
October „	3	9	...	2
November „	6	5	...	...
December „	4	...	...	...
January 1885 . . . . .	...	2	...	...
February „	3	2	1	1
March „	3	3	1	...
TOTAL	52	64	6	14

Fifty-two complete sets of daily observations and six long series, together with 64 imperfect sets of the former and 14 of the latter, are therefore the total result of seventeen months' work. The question naturally presents itself how the capabilities of Leh, as an observing station for actinometric work, should have been so greatly over-estimated when the scheme was originally planned. The station was selected on the unanimous testimony of the most experienced officers; one of whom, Dr. Cayley, was for some years a resident at Leh, and another, General Walker, based his opinion on the reports of the Survey officers who were engaged for several years in the Survey of Ladak, and whose work gave them peculiar advantages for correctly estimating the clearness of the atmosphere. With the single exception of Mr. deNiceville, who, at the meeting of the Asiatic Society in February 1883, expressed a doubt whether the atmosphere would not be obscured by dust, the testimony was uniformly in favour of the selection; and the single objection raised by Mr. deNiceville has not been found valid on experience. The only

explanation that can be offered is that, there appears to have been really a change in the prevailing atmospheric conditions of Ladakh during the last few years. This opinion has been distinctly expressed by the Revd. A. W. Heyde, in connection with another subject; and his experience as a resident in the North-Western Himalaya for 30 years past, in conjunction with the fact that Mr. Heyde is a man of careful observant habit, entitles his opinion to very considerable weight. Both General Walker's and Mr. Heyde's remarks have been quoted in the foot-note at page 6 of this report and need not here be reproduced.

Sergeant Rowland and his assistant Mr. Shaw will return to India at the close of the present season, leaving Leh in time to ensure their reaching the passes before they shall be obstructed by the early winter snows.

SUNSHINE RECORDS.—The automatic registration of the duration of sunshine, which was carried on at Calcutta and Allahabad in the previous year, was commenced at the Maharajah's observatory, Jeypore, in January 1884, and instruments have been ordered from England for the purpose of extending it to some other stations. The instrument, used for this purpose, is a glass sphere, mounted in such a manner that the sun's rays, falling upon it, are focussed on a strip of card-board held in a ring-shaped support. This retains the card at the focal distance from the spherical lens; and between the sun's rising and setting, the path traced by the focus along the card strip burns its own record, being of course interrupted during such time as the sun is obscured. The cards are printed with the proper graduation in hours, so that the hours of the sun's obscuration can be at once read off. The durations of sunshine and cloud are important, not only as an element of climate in relation to health and agriculture, but also as a datum for physical meteorology; since it indicates the time during which the solar heat is being extended on the earth and lower atmospheric strata, and on the higher and cloud-forming strata respectively.

FIRST CLASS OBSERVATORIES.—The provision of proper buildings for the proposed first class observatories at Lahore and Allahabad, which has been in abeyance for nearly ten years, has at length been partially and will shortly be wholly effected. In April 1884, I visited Lahore while on a short tour of inspection in the Punjab, and on learning that a small building in the neighbourhood of the jail, the property of Government, would soon be vacated, I visited it and found that the site was as suitable for the establishment of an observatory as could reasonably be expected in the immediate neighbourhood of a provincial capital. Application was accordingly made to the Punjab Government for the reversion of the building and granted; and the Observatory and Meteorological Reporter's Office were moved into it on the 1st January 1885.

In the meantime, the meteorograph, originally intended for Lahore, having been disposed of to the Maharajah of Jeypore, for the excellent observatory established at his capital, steps were taken to provide self-recording instruments to replace it. It has not been thought desirable to obtain another meteorograph, as, in the circumstances of the Lahore observatory, something much simpler and demanding less experience in the use of delicate mechanism and practical physics, would be more suitable. Such appear to be the instruments devised by Dr. Draper and in use for some years at the New York observatory. Mr. Hill, the Meteorological Reporter to the Government of the North-Western Provinces and Oudh, being on a tour in America in 1883, visited this observatory and reported in favour of the instruments, which he found to work satisfactorily and to be very

much simpler in their mechanism than the beautiful meteorograph of Van Rysselberghe. Accordingly a set has been ordered for the Lahore observatory, and meanwhile, pending their receipt, the work of the observatory will be carried on in the same manner as hitherto.

The Allahabad observatory is now in course of erection on the site selected for it in the Chatham lines, as announced in my report for last year. Meanwhile, thermometric and hygrometric observations have been carried on, simultaneously, at the new and old observatories, since September 1884; with a view to ascertaining the difference, if any, in the normal values of the two sites, and thus determining the corrections that must be applied to the registers of past years, to render them comparable with those of the new observatory. These show that the change of site will introduce an appreciable change into the normal values of radiation, temperature, and humidity; and since the characteristic features of each year are only usefully estimated as departures from those normal values, they afford further evidence how important it is to any sound system of meteorological registration, never to introduce changes of site or method that can be avoided; and, in the event of such change being unavoidable, how necessary it is to ascertain by comparative observations, sufficiently prolonged, the amount of the resulting change at different seasons of the year. In the case of tropical observatories, this is probably even more important than under the duller skies of the temperate zone. The meteorograph intended for the observatory is now in Calcutta.

NATIVE ASSISTANT.—Hitherto, all the officers of the department have been Europeans, who have either received a special education in science; or have been trained in the technical work of a meteorological office. During the past year, it was resolved, as an experiment, to endeavour to train an educated native to undertake the preparation of the daily weather reports and thus set free the Assistant Reporter Mr. Dallas, who has hitherto been engaged on this work, for the performance of administrative duties. After some enquiry from the heads of the principal colleges of the Upper Provinces, Lalla Ruchi Ram Sahni, a native of the Punjab, who had taken his B.A. degree in Physical Science, and has since passed the examination for the M.A. degree, was selected for the post of native assistant, and since January has been engaged in learning the special work of the department. So far his progress has proved very satisfactory, and there is reason to believe that with some further experience he may be entrusted with this part of the daily work.

The experiment is of some special interest, as the employment of natives in purely scientific work, as distinguished from the practice of scientific arts (medicine, surgery, and engineering), is comparatively new; the only previous attempt of a similar character, as far I am aware, being the employment of native assistants on the Geological Survey of India. Lalla Ruchi Ram Sahni has shown much intelligence and aptitude, and promises to become a useful addition to the scientific staff of the department.

RAINFALL STATISTICS.—Some further additions have been made to the stations that send in regular monthly returns of the rainfall to the Central Office, from parts of the country that have as yet been inadequately represented. The most important of these are eight new stations in Rajputana, chiefly in Western Rajputana, a region which a few years ago presented a blank on our rainfall charts. For these I am indebted to the exertion of Dr. Hendley, the Residency Surgeon of Jeypore, who had previously reformed

and virtually re-established the excellent observatory founded and supported by the Maharajah of the State. The newly established rain-gauge stations are—

Kerowlee.	Barmer.
Didwana.	Jasol.
Nagar.	Pali.
Phalodi.	Sirohee.

The largest blanks, now remaining, are the region north of Bickaneer and the Native States of Bahawalpore and Khyrpore.

Since the publication of the chart of the average rainfall of India, drawn up in 1882, and published in 1883, charts have been prepared, on a smaller scale, showing the average rainfall of the three chief Indian seasons, *viz.*, the monsoon (June to October), the cold weather (November to February), and the spring (March to May). Several copies of these have been furnished to Government, and they have also been lithographed on a reduced scale for illustrating a memoir on the rainfall of India, now in part ready for the press. Charts of the rainfall of the corresponding seasons of the past year have also been prepared for Government; and the preparation of similar charts of each season of the current year will henceforth form a part of the regular routine of the department.

SNOWFALL REPORTS.—The system of monthly snowfall reports, established two years ago, has furnished very useful information, which has been utilized for attempting a forecast of the monsoon. The reports are of very various degrees of detail and merit: some being restricted to the mere perfunctory statement of some local snow measurement in the baldest style of official return, while others give evidence of careful enquiry and observation appreciatively conducted, the result being condensed in a concise and intelligent report. Among the best of these latter are those of the Assistant Commissioner of Kulu and the Deputy Conservator of Forests, Bushahir. For very excellent reports on the state of the snows of Lahoul, as well as for much other meteorological information, I am indebted to the Revd. A. W. Heyde, resident at Kailang.

FORECASTING THE MONSOON RAINS.—The experience of the last two years has tended strongly to confirm the idea, put forward originally in the report on the meteorology of India in 1876, that the Himalayan snowfall exercises a prejudicial influence on the monsoon rainfall of the plains. But much more experience is necessary, before it will be possible to say, with any confidence, what part of the country is most likely to be affected in any given season. In some years, the dry west or north-west winds, which blow during drought, are more prevalent in Western India and the Deccan; in others they seem rather to be restricted to the North-Western Provinces and Rajputana; and the only indication that we have, at present, to show in which of these alternative areas they are most likely to prevail in any season, is that afforded by their especial predominance, in one region or the other, during the period immediately preceding the rainy season.

In the spring of 1884, the snows on the North-Western Himalaya were more extensive and later than they had been in any previous year since 1878; and in a memorandum, dated 7th June, the following attempt was made to forecast the prospects of the season:—
“ I look for a somewhat retarded or weak and interrupted monsoon in the earlier months, in part or parts of North-Western India, extending possibly, but by no means necessarily, to the northern portion of the Bombay Presidency and Rajputana. This is the area that experience has shown to be most subject to the anomalous prevalence of dry westerly

winds in the monsoon, as it is that of their normal prevalence in the spring. But it is not likely that the whole of this area will be simultaneously affected, and it is equally unlikely that the conditions, now existing, will operate through the whole of the monsoon. In many respects, the present season resembles the first part of 1876."

The result, as stated in the monthly weather summaries for June, July, and August, was as follows:—"On the 19th June, rain became pretty general throughout the country; the only exceptions being portions of Bundelkhand and the North-Western Provinces, Sind, and Central India. On the 22nd, however, the rainfall on the west coast was checked, and the break spread gradually from the west coast to a very large part of India. Towards the close of the month, precipitation was slight in most places, and had entirely ceased in Guzerat, Central India, Rajputana, and on the plains of the Punjab, and the North-Western Provinces. Rain continued, however, in the Central Provinces and Bengal, and . . . the rainfall of these two provinces was slightly in excess of the average."

"In July, . . . over the greater part of the plains of the Punjab, as well as in Rajputana, Sind, and Guzerat, rain of any consequence was almost entirely wanting during the first fortnight; as was also the case in some parts of the Carnatic, in Madura, Mysore, the ceded districts of the Madras Presidency, and the Deccan. By the 16th, however, a change set in. Rain-bearing winds spread suddenly over Guzerat and subsequently extended to Rajputana and the Punjab. From the 20th to the end of the month, the rains were general and abundant, with the exception of the Madras Presidency." "In August, in the Punjab, except at Rawalpindi, on the hills and at Delhi, there was more or less deficiency; but over nearly the whole of the North-West Provinces, there was excessive rain. From Allahabad eastward, however, in Behar, Bengal, and as far as Burma, the rainfall was generally deficient. Rajputana, like the Punjab, had a somewhat scanty rainfall. On the west coast, from Ratnagiri southwards, the fall was above the average, but both on the coast north of Ratnagiri and at almost every peninsular station to the east of the Ghats, the amount of rain was below the average of the month."

"In September, the rainfall was abundant in Northern India, except in Behar, Northern Bengal, and Assam; but in the peninsula it was still deficient in the Deccan, Mysore, and the Carnatic."

Hence it may be asserted that the predicted retardation or interruption of the rains of the early part of the monsoon of North-Western India was fully justified by the event. After a general burst in the latter part of June, the rains of all Western and North-Western India were entirely suspended for three weeks or more, and even up to August they were somewhat defective in the Punjab. But the conditions, there existing, did not operate through the whole of the monsoon, and the latter months brought abundant rain.

Nothing was said in the forecast respecting the deficiency of the Bengal rainfall in the latter part of the season, nor of that of the Deccan, Bellary, Mysore and the Carnatic, nor at present are the conditions that brought about that deficiency at all well understood. These are subjects for future enquiry.

FLOOD WARNINGS, BOMBAY.—On the 26th July 1884, heavy floods occurred in the Rivers Tapti and Nerbudda, which resulted in the submergence of a portion of the city of Surat; and these were followed, on the 31st, by the flooding of the Subarmati, Mahi, and neighbouring rivers which discharge into the Gulf of Cambay, causing serious breaching of the Bombay and Baroda Railway. Again, on the 3rd September, the same rivers were

in flood, with the like disastrous consequences. All these floods, and also a flood which occurred in September 1882, were the consequence of small cyclones of the south-west monsoon type, which either travelled to Western India from Bengal or the Central Provinces, or, in the last instance, had travelled up the west coast at the end of August.

Shortly after the last occurrence, it was proposed by Mr. Pearson, the Officiating Reporter for Western India, to extend the Bombay storm warning system, with a view to giving notice to the Civil Officers of such districts in Guzerat and Khandesh as are particularly exposed to floods, and to add Rajkot, Mount Abu, and Chikalda to the list of stations sending daily telegrams to Bombay, at a cost of ₹2,500.

On the report being referred to this office by the Government of Bombay, it appeared that the object in view might be achieved in a more satisfactory manner, without additional expense, by utilising the existing Imperial system of telegraphic report. It was pointed out that the storms, which had caused these disastrous floods, had been traced from their origin in the daily weather reports issued by the Simla Office, and that in all cases in which there appeared any possibility of their bringing stormy weather to the Bombay coast, their progress had been reported by urgent telegram to the Bombay Meteorological Office. Also, that it had been previously the practice of the office to telegraph or cause to be telegraphed to certain officers of the Irrigation Department who had desired it, the occurrence of heavy rain around the head waters of certain rivers in Central India; and that information of a similar character could, if desired, be communicated to the Civil Officers of Surat and other districts, that might be threatened with floods.

It was accordingly proposed that the Superintendents of the Observatories, situated near the head waters of the Tapti and Nerbudda, should be instructed that, in the event of the rainfall exceeding 3 inches in the 24 hours, an urgent telegram should be sent to such officers as the Bombay Government might name, and further, that premonitory warnings should be sent from the Simla Office, giving notice of the approach of a storm to the Central Provinces, Central India, and Guzerat.

These proposals having been approved by the Government of Bombay, the necessary steps were taken to give them effect, and already, during the present season, one such warning has been issued, although, as the event showed, all further consequences were averted, by an unexpected change in the path followed by the storm.

At the same time, the Meteorological Reporter for Western India has been requested to take up the question of these floods, and investigate the circumstances attending their origin, with a view to the greater efficiency of the system. This step had been proposed by Mr. Pearson, *proprio motu*, but as that gentleman vacated his appointment in November last, on Mr. F. Chambers' resuming charge of his own office, it remains for Mr. Chambers to carry it out.

THE LAWS OF STORMS.—A very important addition has been made, during the past year, by Mr. J. Eliot, Meteorological Reporter to the Government of Bengal, to his previous admirable work on this important subject. In previous reports, he has traced out in detail the history of several individual storms from their origin, and has thus, by comparative methods, arrived at several very important generalizations, which have placed our knowledge of the conditions of cyclone formation on a firm basis; an undertaking for which the geographical conditions of the Bay of Bengal offer peculiar advantages.

He has now treated the whole question of storm formation and storm tracks in a much more comprehensive manner. Taking as the basis of his work, the daily weather charts of India, which have been drawn up in the Meteorological Office since 1877, he has taken out the track of every storm generated over the Bay of Bengal, between the months of May and December, during the five years 1877—1881 (forty-six in all), and has discussed them, at such length as the available data admit of, in a memoir of 216 quarto pages, illustrated by 7 plates, which has been recently issued as Part IV of Volume II of the Indian Meteorological Memoirs. The following are some of the more important conclusions which Mr. Eliot has established as the result of the enquiry.

Cyclonic storms are a regular and frequent feature of the whole south-west monsoon period, and are of all degrees of intensity.

The prevalence of steady south-west winds, giving general rain over the land area of Northern India, for more than a few days, is an event of comparatively rare occurrence. The atmospheric action during the south-west monsoon is intermittent and oscillatory. A weakening of the monsoon current is usually accompanied by its retreat southward; during which interval, any rainfall is light and partial; and these breaks in the rains are each followed by a renewed advance of the monsoon, each advance being preceded by conditions similar to those which usher in the monsoon on its first establishment. The formation of a cyclonic storm is frequently the result of such advance.

Notwithstanding that the Bombay branch of the monsoon, where it crosses the coast, is nearly twice as strong as the Bengal branch at the head of the Bay, there is not a single instance of a storm from the Arabian Sea having crossed from west to east. On the other hand, numerous storms are recorded as having originated at the head of the Bay, and crossed completely the head of the peninsula from east to west, disappearing near or in the Arabian Sea.

The following has been the distribution of cyclonic storms during the five years 1877—1881, according to the three seasons, the change from the winter to the summer monsoon, the summer monsoon, and the change from the summer to the winter monsoon.

	1877.	1878.	1879.	1880.	1881.	TOTAL.
May	1	0	2	1	1	5
June to September	6	5	3	6	8	28
October to December 15th	1	4	4	2	2	13

It was formerly supposed that the majority of the storms occurred at the change of the monsoons. This is now shown to be erroneous. But the error is explained by the fact that, the storms of the transitional periods are more severe and destructive, and hence have been recorded as storms, while the less severe storms of the monsoon have escaped notice as such.

With respect to the course of the storms and the part of the coast affected by them, the following table shows their distribution in the eight months, May to December:—

Number of Cyclones during the five years 1877—1881.

MONTHS.	Burmah coast.	Bengal coast.	Orissa coast.	Ganjam coast.	Circars coast.	Coromandel coast.
May	2	1	...	...	2
June	1	3	...	...	...
July	1	3	1	...	...
August	3	8	...	...	...
September	2	5	1	...	...
October	1	1	1	3	...
November	2	...	...	...	1	3
December	1	...

This shows that the intersection of the storm tracks and the coast advance and retreat with the monsoon, confirming the conclusion previously arrived at from the study of violent storms only, a list of which was published in 1877, in the Journal of the Asiatic Society of Bengal.

Cyclones of the transitional periods are of low elevation, the vortex being restricted to a moderate thickness of the lower atmospheric strata. Within this stratum, the barometric disturbance is much greater, and the winds more violent, than in the storms of the monsoon period; but after reaching the land, they are more readily broken up on meeting low hill ranges. Those of the monsoon are of great elevation, the barometric disturbance is slight, and the winds rarely of destructive violence, but the storms are more lasting and frequently cross the whole breadth of Northern India, being but little affected by the irregularities of the land.

MARINE METEOROLOGY.—Mr. Dallas has completed the set of monthly charts, showing the distribution of barometric pressure, the prevalent winds and marine currents of the Bay of Bengal; and the January chart has been lithographed on a reduced scale as a specimen of the work, and circulated to the Port officers, Marine Weather Institutes, and some ship commanders, for criticism, with a view to obtaining opinions on its utility and suggestions for improvement. Several replies have been received, and some valuable suggestions offered, among which I would especially notice the report of Dr. C. Neumayer, the Director of the German Seewarte at Hamburg.

Having regard to these, some modifications will be made in the plan of the charts, the lithographing of which will now be proceeded with. Dr. Neumayer has suggested the

advantage of the several Marine Institutes assisting each other with the data at their disposal, and informs me that the German Institute can furnish a considerable quantity of material for some parts of the Bay of Bengal charts, for which those furnished by the London Meteorological Office are most deficient. It seems most desirable that this offer should be accepted, but I do not propose to defer the publication of the charts for this purpose, but would rather look forward to the issue of the revised and improved edition at some future date.

Meantime, the barometric, wind and current charts of the Arabian Sea are now being taken in hand, as I consider it of more importance to prepare and publish these at an early date, than to deal with the temperature data of the Bay of Bengal.

Up to the date of his departure on furlough, Mr. Eliot continued the collection of marine logs for the Bay of Bengal from vessels visiting the Port of Calcutta. One hundred and sixty-six returns were received during the year, the log-books being in many cases sent in by the captains spontaneously without special application, and in other cases, they have themselves called at the office with the extracts made by themselves. There is, therefore, a very cordial response on the part of officers of the mercantile marine to the invitation issued by Mr. Eliot, and that gentleman has made much use of the information collected, in the cyclone reports he has prepared and published in the Meteorological Memoirs.

PART III.

OBSERVATORIES.

AT the close of the official year 1883-84, there were 127 observatories contributing registers to the Central Office, as announced in the report for that year; exclusive of 22 which had been established in Bengal as a part of the provincial system. One of these, indeed, Mahé in the Seychelles, had not contributed any register since January 1884, and as none has been received since, it may be regarded as virtually non-existent. Another extra Indian observatory, Zanzibar, ceased to send registers in December 1884, owing to the death of the officer who had continued the meteorological observations, after the transfer of the agency to Her Majesty's Foreign Office. On the other hand, a new observatory has been established at Chamba in the North-West Himalayan hill-state of that name, and another at Rajahmundry in Madras. Instruments have also been lent to Father Desgodins, S.J., in charge of a missionary station at Pedong in British Bhutan, for the equipment of a small observatory at that station on the volunteer system. Thus 128 observatories were in existence on the 31st March 1884, as already stated in Part I. of this report, and 129 contributed registers for the whole or a part of the year. A list of these, specifying the classes to which they severally belong, has been given at pages 2-4.

OBSERVATORIES IN BENGAL AND ASSAM.—*The Alipore Observatory.*—This observatory serves as a general dépôt for the verification of instruments, as well as for observations of an experimental character, and an important part of the work is the working of the time signals for the Port of Calcutta. It is immediately superintended by the

Reporter to the Government of India, and the establishment is under the immediate charge of the Chief Observer, Babu Brojo Mohun Rakhit, B.A. During the past year the work of the observatory has consisted of—

1st.—Continuous registration, by autographic instruments of (*a*) the duration of bright sunshine, (*b*) the atmospheric pressure, (*c*) temperature, (*d*) moisture (dry and wet bulb thermometers), (*e*) wind direction, movement and pressure, and (*f*) rainfall.

2nd.—Periodical readings, five times daily, of the barometer, dry and wet bulb thermometers, measurements of rain and estimates of cloud proportion, once daily of the maximum and minimum thermometers in shade, those of the exposed thermometers for nocturnal radiation and insolation, and thrice daily those of the ground thermometers at the surface, 1 foot, 3 feet, and once at 6 feet deep. Also occasional observations on the movements of the higher clouds by means of the nephoscope.

3rd.—The verification of all thermometers issued to observatories throughout India, with the exception of those under the Meteorological Reporter for Western India, and the comparison of all barometers with the Calcutta standard.

4th.—The determination of the mean local time, by meridian observations of the sun, and the working of the time signals for the guidance of the shipping in the port. Also the custody and rating of Government chronometers.

The establishment for the above purposes consists of—

Babu Brojo Mohun Rakhit, B.A.	.	.	.	.	.	Chief Observer.
„ Annoda Prosad Banerji, B.A.	.	.	.	.	.	1st Photo. Asst.
„ Ramchandra Chakravarty	.	.	.	.	.	2nd Ditto.
„ Mohindro Nath Banerji	.	.	.	.	.	Observer.
„ Shyam Lall Sen	.	.	.	.	.	Ditto.
2 Artificers.						
1 Batteryman.						
6 Servants.						

The autographic instruments consist of a sunshine recorder, the Kew barograph and thermograph, which register by photography, a Beckley's anemograph, an Osler's anemometer and a Beckley's rain-gauge. During the past year, with but slight exceptions, the instruments have worked well. There has been a great improvement in the working of the barograph and thermograph, owing to increased care on the part of the observatory establishment, and the interruptions of the photographic records have been much fewer than in any preceding year. The Beckley's anemograph by Adie, which had been in operation since the establishment of the observatory in 1877, was dismantled in November last and replaced by a new and improved instrument, on the same principle, constructed by Casella.

From the following comparative table of the readings of the standard barometer and the barograph traces, it appears that the values of the latter instrument underwent a sudden fall in March 1884 (*viz.*, on the 19th), which was due in all probability to a small bubble of air having penetrated the Torricellian vacuum. Since that date, the values seem to have remained practically constant, the average of the nine months, April to December, indicating a permanent depression of '031 inch below those of the standard. This has been applied as a correction to the measurements of the traces from the date of the change.

Comparative mean reduced readings of barograph and standard barometer in 1884.

1884.	STANDARD BAROMETER.					BAROGRAPH.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
January	30'053	30'129	29'996	30'070	30'062	30'044	30'127	29'995	30'068	30'059
February	29'966	'045	'903	29'983	29'974	29'959	'044	'901	29'982	29'972
March	'831	29'896	'758	'849	'834	'816	29'884	'744	'837	'820
April	'767	'821	'687	'774	'762	'738	'793	'658	'746	'734
May	'664	'707	'595	'675	'660	'632	'680	'564	'647	'631
June	'587	'626	'526	'609	'587	'554	'596	'492	'577	'555
July	'530	'569	'479	'555	'533	'492	'537	'442	'522	'498
August	'582	'626	'530	'616	'589	'543	'590	'491	'582	'552
September	'682	'734	'618	'710	'686	'645	'701	'582	'678	'652
October	'889	'942	'831	'897	'890	'859	'919	'803	'871	'863
November	'973	30'029	'911	'981	'974	'943	30'007	'886	'959	'949
December	30'071	'135	30'003	30'077	30'072	30'042	'110	'978	30'053	30'046
Year	29'800	29'855	29'736	29'816	29'802	29'772	29'832	29'711	29'794	29'778

The following table gives a comparison of the readings of the dry and wet bulb thermometers under the usual thermometer shed, with the measurements of the corresponding thermograph traces. The mean differences are almost exactly the same as in the year 1880, the first year in which a comparison was instituted. There is an apparent rise of 0.1° in the thermograph traces, which may well be due to a real rise of the zeros of the thermograph tubes. The original difference 0.3° may be due either to the same cause, or, as is equally probable, to a real difference of temperature under the open shed and under the thermograph pent-house.

Comparative mean readings of the Thermograph and Dry bulb Thermometer in the Thermometer Shed, in 1884.

1884.	THERMOMETER IN SHED.					THERMOGRAPH (DRY BULB).				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	°	°	°	°	°	°	°	°	°	°
January	55.8	67.6	75.2	60.2	64.7	56.6	66.1	73.9	61.2	64.5
February	60.4	72.0	79.4	64.6	69.1	61.3	70.6	78.3	65.3	68.9
March	72.5	84.0	91.8	76.8	81.3	73.6	83.2	91.2	77.9	81.5
April	76.2	88.3	93.6	80.1	84.6	77.6	88.4	94.2	81.6	85.5
May	77.9	85.8	83.4	79.1	82.8	79.0	86.7	89.1	80.3	83.8
June	78.7	85.4	86.8	79.7	82.7	79.6	86.1	87.4	80.8	83.5
July	79.5	83.1	84.1	81.1	82.0	80.3	83.9	84.8	81.6	82.7
August	79.0	83.3	84.1	80.3	81.7	79.7	84.7	84.9	81.1	82.6
September	77.7	82.5	82.3	79.3	80.5	78.5	83.0	83.1	80.0	81.2
October	73.7	81.2	83.0	75.7	78.4	74.6	81.1	83.0	76.6	78.8
November	62.7	73.8	78.1	65.5	70.0	64.0	73.0	77.3	66.5	70.2
December	57.3	68.9	74.8	60.5	65.4	58.6	67.9	73.9	61.4	65.5
Year	71.6	79.7	83.5	73.6	76.9	72.0	79.6	83.4	74.5	77.4

Comparative mean readings of the thermograph and wet bulb thermometer in the Thermometer shed, in 1884.

1884.	WET BULB IN SHED.					THERMOGRAPH (WET BULB).				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	°	°	°	°	°	°	°	°	°	°
January	54·4	60·5	61·8	57·9	58·7	54·3	59·7	61·5	58·3	58·5
February	58·7	63·8	63·8	61·3	61·9	59·0	63·1	63·8	62·4	62·1
March	70·8	72·9	70·7	72·5	71·7	71·5	73·5	72·4	73·4	72·7
April	74·2	76·6	75·8	75·8	75·6	74·9	77·4	77·3	76·6	76·6
May	75·8	79·0	79·0	75·9	77·4	76·6	79·7	80·0	76·6	78·2
June	77·2	80·2	80·1	77·3	78·7	77·7	80·9	80·9	77·9	79·4
July	78·3	79·6	79·9	79·0	79·2	78·6	80·1	80·3	79·3	79·6
August	77·9	79·2	79·5	78·2	78·7	78·3	79·9	80·5	78·7	79·4
September	76·7	78·3	78·0	77·5	77·6	76·9	78·7	78·6	77·8	78·0
October	72·4	74·1	74·4	73·8	73·7	73·0	74·6	75·0	74·3	74·2
November	60·4	65·1	65·6	63·0	63·5	60·9	64·8	65·8	63·6	63·8
December	55·7	61·5	62·3	58·5	59·5	56·0	61·2	62·4	58·8	59·6
Year	69·4	72·6	72·6	70·9	71·4	69·8	72·8	73·2	71·5	71·8

The sunshine recorder has worked satisfactorily and without interruption.

The observations of ground temperature at the surface, and at depths of 1 foot and 3 feet have been steadily continued, and an additional series was commenced in March 1884 with a thermometer at a depth of 6 feet. The series at 1 foot deep has been carried on with two thermometers, for the reasons stated, and in the manner described in the report for last year. The result of another year's comparative readings fully accords with that of the first year, as stated in the report for 1883-84. There is no doubt that the temperatures, shown by the old thermometer at 1 foot, were seriously affected by the connection of air in the wooden tube, resulting in a lowering of the night temperatures, which in certain months exceeded 1°. The comparison of the two instruments will however afford the means of correcting these erroneous registers, and thus they will eventually be made available for discussion. An abstract of the registers is given in the Report on the Meteorology of India for the year 1884.

The number of instruments verified at the Alipore observatory during the year ending 31st March 1885 is as follows :—

	Instruments.	No.
Barometers	61
Aneroids	11
Dry and wet bulb thermometers	37
Maximum thermometers for air temperature	55
Minimum do. do.	28
Do. do. for nocturnal radiation	24
Solar radiation thermometers	5
Standard do.	14
Six's do.	1
Salinometers	6
TOTAL		242

and the following is a return of those received and issued by the Observatory Store Department:—

	Instruments.	Received.	Issued.
Barometers	.	41	63
Aneroids	.	7	5
Dry and wet bulb thermometers	.	19	49
Maximum thermometers for air temperature	.	19	44
Minimum do. do.	.	21	32
Do. do. for nocturnal radiation	.	25	34
Solar radiation thermometers	.	6	38
Standard do.	.	2	7
Six's do.	.	0	1
Sling do.	.	0	3
Actinometers	.	0	3
Salinometers	.	6	6
Hypsometers	.	0	6
Anemoscopes	.	0	6
Pyrheliometer	.	0	1
TOTAL		146	298

Both receipts and issues are very considerably less than in the previous year, notwithstanding that the issues include a large number of instruments simply transferred to the Meteorological Office, and not issued to observatories; the corresponding return for 1883-84 having been swollen by the issues for the equipment of 22 provincial observatories in Bengal.

The time signals have continued to work in the same satisfactory manner as in the previous year. Two time balls are dropped from the Alipore observatory, the one on the Semaphore tower in Fort William, the other on the Port Commissioners' Office on the Strand. Both balls dropped correctly on 286 days. One failed on 1 day only, the other on two days. The remaining 76 days were Sundays or public holidays.

Table showing the occasions of failure of two time balls during the official year 1884-85.

Dates of failures.	Nature of failure.
25th April 1884 . . .	Time ball at the Port Commissioners' Office failed altogether.
23rd July „ . . .	Time ball on the Semaphore tower, Fort William, dropped a few seconds late.
10th March 1885 . . .	Time ball on the Semaphore tower, Fort William, dropped a few seconds late.

OTHER OBSERVATORIES IN BENGAL AND ASSAM.—The twenty-three observatories, which have been established in Bengal for the purposes of the provincial system of daily weather report, are not at present included in the Imperial system. They are enumerated in the note below.¹ Excluding these, there are in Bengal and Assam 22 observatories in addition to that of Alipore.

¹ The observatories established for the system of daily local report in Bengal are the following:—

Balasure.	Mymensingh.	Buxar.
Midnapore.	Rampore Bauleah.	Arrah.
Raneegunge.	Dinagepore.	Dehree.
Noakholly.	Rungpore.	Nya Doomka.
Burrisal.	Julpigoree.	Ranchee.
Serajgunj.	Bhagalpur.	Chybassa.
Comillah.	Chupra.	Bogra.
Furreedpore.	Motiharee.	

The list has already been given at page 2.

In Mr. Pedler's Report (Appendix A) are given the names of the superintendents and observers at all the second and third class stations and also at Demagiri and Tura. The Chowringhee observatory is attached to the Meteorological Office, the clerks of which record the observations; and Mongpoo and Pedong are included in the list of stations which report direct to the Central Office (Appendix E).

Mr. Pedler reports that two of the second class observatories, Hazaribagh and Cuttack, were visited by his head clerk; the former was found to be in fair, the latter in very satisfactory condition. The Dhubri observatory shed was burnt down in April 1884, and as, for unexplained reasons, it was not till November that it was reconstructed, only an imperfect register could be kept during the interval. The observer at this station, a very careful and trustworthy man, Muniruddin Ahmed, died while absent on sick leave, shortly before the reconstruction of the observatory was completed. Mr. Pedler reports that the rest of the second class observatories continued to furnish satisfactory returns throughout the year; but an exception must, I think, be made of Saugor Island, where the registers of one instrument were grossly erroneous throughout the year, owing to the observer's neglect of the official instructions. Of the third class observatories, three, *viz.*, Darjeeling, Durbhunga, and Jessore, were inspected by Mr. Eliot, and two, Gya and False Point, by the head clerk of the Bengal Office. At Darjeeling, the Casella's anemograph, which had entirely failed to give useful records, was replaced by the Beckley's anemograph, which had previously been in use at Alipore. This was set up in March, in an excellent position on the summit of Mount Vernon, (7,509 feet above the sea), and was at work just before the close of the year under report. This is an excellent observatory.

The Gya observatory has long been very unsatisfactory. I have had to reject the whole of the barometric registers of this station for 1884 as untrustworthy, and Mr. Pedler reports equally unfavourably on some other classes of observations. The observer has twice been under suspension of his meteorological allowance during the past year. But Mr. Pedler reports that there has since been an improvement in his work.

The Jessore observatory was found to be in good order, but the position is a confined one. The Durbhunga observatory, which was unfavourably reported on last year, has much improved. The False Point observatory is highly spoken of, and also those of Berhampore and Burdwan. And, generally speaking, the returns from the third class stations were satisfactory.

The following observers have had special allowances allotted to them for the current year:—

Names.	Stations.	Amounts.
		R
Makhadaprosad Chowdhry	Burdwan	10
Mahendronath Roy	Berhampore	10
Dandadhar Datta Barua	Sibsagar	10
W. H. Alley	Cuttack	5
Nathoo Lall	Hazaribagh	5
Romesh Chundra Buddha	Silchar	5
Poreshnath Raichowdhry	Jessore	5

OBSERVATORIES IN THE NORTH-WESTERN PROVINCES AND OUDH.—The seventeen observatories in these provinces have been enumerated on page 3. With the

omission of Pauri, they are the same as in the previous year. The names of the superintendents and observers are given in Appendix BII to Mr. Hill's Report.

The Allahabad observatory has continued on the footing of a second class observatory, but the building for a first class observatory to be established on the Chatham lines has been put in hand and is expected to be finished in November next.

Of the second class observatories, one only, *viz.* Agra, has been inspected during the year. The condition of the observatory was found to be satisfactory. The work of the Roorkee observer shows much improvement, and is now nearly equal to that of the best observers in the provinces. It is intended to reduce the existing second class observatories in the North-Western Provinces to the third class scale, as soon as the Allahabad observatory shall be in readiness to commence work as an observatory of the first class.

Of the third class observatories in the North-Western Provinces and Oudh, none have been visited during the year. Judged from the character of the registers sent in, they are working in a satisfactory manner.

The following observers have been granted special allowances for the year now current :—

Names.	Stations.	Amounts.
		R
Kadernath Chatterjee	Allahabad	10
Chotoy Lall	Lucknow	10
Jawa Nand	Ranikhet	10
Chiranji Lal	Roorkee	10
Mir Altaf Ali	Agra	5
Siligram	Chakrata	5
Devakinandan Pathak	Benares	5

OBSERVATORIES IN THE PUNJAB.—The number of observatories in the province has been increased to thirteen by the establishment of an observatory at Chamba. This being required chiefly for the study of Himalayan meteorology, especially in connection with the snowfall, is immediately under the Central Office, as are also those of Kailang in Lahoul and Leh in Kashmir. The remainder are administered by the Reporter to the Punjab Government and are briefly dealt with in Mr. Oman's report, Appendix C. The names of the superintendents and observers are given in Appendix CI.

As already noticed in the introductory portion of this report, the Lahore observatory has been at length removed from the Mayo Hospital, where it was originally established in 1872, to a building about 3 miles distant further from the city and in a more open and far more suitable site. This change was effected on the 1st January 1885. By this removal, which had become unavoidable, the conditions under which the observations are recorded have been materially changed; and, as has already been experienced in the case of the Calcutta and Allahabad observatories, it may be expected that the normal temperature, humidity, &c., of the new site will be found to differ very appreciably from those resulting from the observations of past years. In order to ascertain this difference approximately and to render the past registers comparable with those of the new observatory, observations of temperature and humidity will be carried on simultaneously at the two observatories, if possible, for two years. The observatory is still carried on the footing of a second class observatory; but since the close of the year under report, it has been furnished with the means of recording the temperature of the ground, and the duration of sunshine, and also with a Beckley's anemograph for registering continuously the direction

and movement of the wind, but this last instrument awaits the erection of a tower to the observatory before it can be usefully set up.

The only other second class observatory under the Punjab Reporter, that of Leh in Ladakh, was transferred to the Central Office, for administrative purposes in July 1884. This also has been removed from its former site, although but a short distance, and it has been attached to the actinometric observatory under the immediate supervision of Sergeant Rowland, the Actinometric Observer.

The observatories of Delhi, Rawalpindi, Ludhiana, Murree, Sialkot, Simla, and Sirsa were inspected by Dr. Lawrie, the Punjab Reporter, and those of Rawalpindi, Murree, and Simla also by myself. The report for the year having been drawn up by Mr. Oman, after Dr. Lawrie's departure, does not give the results of the latter's inspection.

The Murree observatory was found by myself to be in excellent condition as far as depended on the observer, and indeed this has always been one of the best observatories in the province. One or two instruments required cleaning or replacing, and this was effected during or in consequence of my visit. The Rawalpindi observatory was also in satisfactory condition.

The Simla observatory was removed from Bairdville (the house occupied by the Quarter Master General's Office) to the new military staff offices in Burra Simla in the second week in March. The distance is about a mile; and whereas the former site in Chota Simla had a western aspect, the slope of the hill on which the present observatory is situated faces to the south and the elevation of the barometer is 36.6 feet greater than before. As in the case of Lahore, the removal was unavoidable; and it is to be regretted that Bairdville being private property, only temporarily rented by the Government, it has not been practicable to carry on the observations there after the removal of the Quarter Master General's Office.

That some change in the normal or average values of the temperature and humidity registers has been introduced by the change can hardly be doubted, but how great or little it may be can only be a matter of surmise. The difference of the levels between the present and former sites of the barometer has however been very accurately determined by a double line of levels, taken by the direction of the superintending engineer Mr. Irvine. The present site is no better fitted than was the former site for wind observations, and indeed is only temporarily occupied for the purpose of the observatory. It is intended, on the completion of the Townhall, to remove the observatory to the ridge, or the immediate neighbourhood of that building.

The Delhi observatory was inspected by Mr. S. A. Hill while officiating as Reporter to the Government of India. It was found to be in a somewhat neglected condition, the barometer being very dirty, and the thermometer shed in bad repair. The hygrometer was coated with calcareous deposit. The thermometers, most of which had been in use for the past 10 years, was found in several cases to have risen about 0.5° in their scale values, introducing an uncorrected error of that amount into the registers.

The Sialkot observatory furnished some very erroneous reports towards the end of the year, and this was found on enquiry to be due to the repeated change of the observer, and to some of the temporary incumbents being almost wholly untrained.

Respecting other observatories, there is nothing specially calling for notice.

The following observers have had special allowances allotted to them for the current year:—

Names.	Stations.	Amounts. R
Jaspat Rai	Lahore	10
Devanchand	"	5
Wahid Ali	Mooltan	5
Kashi Ram	Peshawar	5
W. Cruikshank	Murree	5
Sergeant J. J. König	Simla	5

OBSERVATORIES IN THE CENTRAL PROVINCES.—The observatories of these provinces, eleven in number, are enumerated at page 3 of this report, and the nominal list of the superintendents and observers is given in Appendix D I., appended to report of the Sanitary Commissioner, Dr. J. H. Loch [Appendix D].

The Sanitary Commissioner has inspected all the observatories in his administration, excepting those at Seoni, Sambalpur, and Sironcha; and the results of his inspection are detailed in his report. The Jubbulpore observatory was also inspected by Mr. S. A. Hill.

Two of the second class observatories, Nagpur and Jubbulpore, have maintained their excellent character, but the Pachmarhi observatory, which is also of the 2nd class, has given cause for serious complaint; Dr. Loch found, on inspecting the observatory, in October last, that the observer systematically neglected the official instructions in his manner of reading the barometer, and as this had been the case for many months, the whole of the barometric registers, from February to October inclusive, have had to be rejected. The thermometer shed was blown down shortly before the inspection, and from that time to the 1st December, the temperature observations cannot be accepted as of much value, the instruments having been placed in a closed building.

Of the third class observatories inspected, the reports are generally favourable, the only serious exception to this remark is afforded by the Sambalpure and Sironcha observatories. At the former, in consequence of the removal of the observatory to a new site, arrangements had been made for simultaneous registration at the old and new observatories to determine the influence of the change on the normal values of the registers. It was found, on examination, that the permanent observer who was charged with the duties at the new observatory, had simply copied the thermometer readings furnished by the temporary observer at the old site, thus defeating the object of the double register.

The barometric registers of Sironcha were also untrustworthy during several months of the year; until the fact having been brought to the notice of the Sanitary Commissioner, the observatory was inspected by the Superintendent of the Chanda observatory in September 1884. The observatory and instruments were found to be in good order, and the bad work must, therefore, have been due to the carelessness or bad faith of the observer. Since he has learned, by this experience, that means exist of checking his work, by comparison with that of other observatories, his registers have ceased to show the former discrepancies.

Special allowances have been granted to the following observers in the Central Provinces for the current year:—

Names.	Stations.	Amounts. R
Krishna Rao	Raipur	5
Sitaram	Chanda	5
Puncham	Seoni	5
P. Soobiah	Nagpur	5
Behary Lal Parasar	Khandwa	5

OBSERVATORIES IN BERAR.—Of the five observatories in this province, enumerated at page 3 of this report, all but Makhla are under the Reporter for Western India, and are noticed in his report (Appendix F), the names of the superintendents and observers being given in Appendix FI. Those of the Makhla observatory, which is carried on by the officers of the Forest Department, are given in Appendix E.

None of these have been inspected during the year, but Mr. Chambers reports that the work of the observatories at Akola and Chikalda has been thoroughly trustworthy, while that of Amraoti and Buldana was for a short time open to objection, either owing to erroneous observations or to faulty manipulation of the instruments.

Special allowances have been granted to the following observers¹ :—

Names.	Stations.	Amounts. R
Samuel Gregory	Akola	10
Hera Lal	Chikalda	5

OBSERVATORIES IN CENTRAL INDIA AND RAJPUTANA.—These are ten in number as in previous years, and they are enumerated at page 3. The Maharajah's observatory at Jeypore, which is a first class observatory, sends in its registers to the Reporter for the North-Western Provinces and Oudh, and a special report by the superintendent Surgeon-Major Hendley is given in Appendix BI.

Of the remaining observatories (all of the third class), those of Nowgong, Sambhar, Sutna, and Ajmere are noticed in Mr. Hill's report (Appendix B); and those of Neemuch, Indore, Mount Abu, and Bickaneer in that of Mr. Chambers, (Appendix F); and the lists of officers and observers are included in the lists respectively appended to these reports. That of the remaining observatory, Pachpadra, which reports direct to the Central Office, is given in Appendix E.

Sambhar and Sutna were inspected by Mr. Hill. With two small exceptions, the instruments at the former were found in good condition, and the work of the observatory is fairly performed. At Sutna everything was in excellent order except the Casella anemograph, which is reported to work stiffly, owing to some fault in construction.

Mount Abu, Neemuch, and Indore were inspected at the beginning of the year under report by Mr. Pearson, who officiated as Reporter for Western India during the greater part of the year. The condition of these observatories was noticed in Mr. Pearson's Report for the previous year.²

Mr. Chambers mentions that the registers of Mount Abu and Neemuch were for a short time 'unreliable.' The barometric registers of the former for June and July have had to be rejected, and that of the latter for November.

The Pachpadra observatory has worked satisfactorily during the past year.

Special allowances have been granted to the following observers for the current year :—

Names.	Stations.	Amounts. R
Ram Lal	Bickaneer	10
Har Nath	Sutna	5
Ram Pershad	Ajmere	5
S. K. Gadgil	Mount Abu	5
Trimbak Rao	Indore	5

OBSERVATORIES IN BOMBAY.—These, fourteen in number, are the same as in the previous year, and are enumerated at page 3. With the exception of the Colaba

¹ Bukarang Pandurang, the observer at Amraoti, subsequently received an allowance of Rs.

² See Administration Report for 1883-84, p. 77.

observatory at Bombay, which is independent of the Meteorological Department, they are dealt with in Mr. Chambers' Report [Appendices F and FI].

Of the four second class observatories, three, *viz.*, Poona, Belgaum, and Kurrachee, were inspected by Mr. Chambers, and the fourth Deesa, was visited by Mr. Pearson and reported on in his report for last year. The results of Mr. Chambers' inspection are given in his report (paragraphs 15, 17, and 21). At Poona and Kurrachee, the instruments were in fair order; but at Belgaum the Beckley's anemograph was found to work badly, owing to its dirty and neglected condition. With one other exception, however, the remaining instruments were in good order. The registers sent in by these observatories are favourably reported on.

The third class observatories at Surat and Malegaon were inspected by Mr. Pearson at the beginning of the year, and those of Sholapur, Ratnagiri, and Karwar by Mr. Chambers. These last alone are noticed in the report [Appendix F, paragraphs 17, 18, and 20]. The condition of the Ratnagiri and Karwar observatories was satisfactory. That of Sholapur less so, owing, as would appear, to a want of intelligence on the part of the observer. Portions of the registers of Hyderabad, Bhuj, and Malegaon have been rejected.

Special allowances have been awarded to the following observers:—

Names.	Stations.	Amounts.
		Rs
Mahadev Cuddum	Ratnagiri	10
Ramkrishna K. Karandikar	Deesa	5
Narayan Sakaram	Poona	5
Govindrag C. Moodlair	Rajkot	5
G. W. M. D'Aranjo	Karwar	5
Ram Chunder Datta	Belgaum	5

OBSERVATORIES IN MADRAS, MYSORE, COORG, AND HYDERABAD.—Of the nineteen observatories enumerated on page 3 all but Madras, Vizagapatam, and Gopalpur are under the Meteorological Reporter to the Government of Madras, and a detailed account of their working during the past year is given in Miss Pogson's report (Appendix G). Nine of these have been inspected by Miss Pogson during the year, *viz.*, the second class observatory at Trichinopoly and the third class observatories at Bangalore, Cochin, Coimbatore, Kurnool, Madura, Negapatam, Salem, and Secunderabad. Two others, *viz.*, Cuddapah and Masulipatam, have been visited and reported on by the head clerk of the Madras office. The detailed result of the inspection are given in Miss Pogson's report. The observatory of Cuddapah was established only a few days before the beginning of the year under report, that of Rajahmundry in May 1884.

The majority of the observatories are favourably reported on, and in general the work of the province has been much improved since Miss Pogson has been appointed to the reportership. The observatories of Bangalore, Cochin, Coimbatore, Mangalore, Mercara, Negapatam, Selem, Secunderabad, Trichinopoly, and Wellington are very favourably noticed as far as depends on the observers. That of Bellary is in general satisfactory, but the observer has given reason for complaint by his dilatory conduct in completing and sending in his registers. Those of Cuddapah, Kurnool, Madura, and Masulipatam have been less satisfactory, and much of the work contributed by the two first mentioned has had to be rejected.

It is necessary to remark, with reference to the insufficient supply of instruments occasionally noticed in the report, that, except occasionally in the case of radiation

thermometers, all requisitions from the Madras office have been immediately supplied, and in some instances instruments have been sent to observatories requiring them, in anticipation of any action on the part of the Reporter's office.

The observers at those observatories in Madras, which were established before the re-organisation of the department under the Government of India, have been paid at a higher rate than at those more recently established, *viz.*, Mercara, Mangalore, Cuddapah, Kurnool, and Rajahmundry, and it has not been deemed advisable to reduce the emoluments of the former to the same scale as the latter, so long as the observatories continued to work satisfactorily on the old system. The more highly paid observers were, however, required to reduce and correct their own registers and thus save some expense to the Reporter's office. This system, however, has not proved satisfactory in many cases, and steps have therefore been taken gradually to reduce both the work and rates of remuneration at the old observatories of the 3rd class, as the former incumbents vacate their appointments. This has been done at Coimbatore and Madura from the 1st June of the year now current, and at Masulipatam from the 1st July, thus effecting a considerable saving of expense, even after providing a small additional establishment for the extra work thrown on the Reporter's office by the change of system.

The Vizagapatam observatory, the private property of Mr. Nursing Row, has continued to furnish its very valuable registers as in former years, and also to transmit daily weather telegrams, both to Calcutta and Simla.

The Gopalpur observatory, established in connection with the system of telegraphic storm report issued by the Bengal Office, works under the direction of that office.

The Madras observatory is, as heretofore, a part of the establishment of the astronomical observatory and is independent of this department.

OBSERVATORIES IN BRITISH BURMA.—These observatories, eight in number as in previous year, are enumerated at page 3. The name of the observer at Akyab is given in the Bengal Report, (Appendix A), that of Diamond Island in Appendix E, and the names of the superintendents and observers of the remainder in Appendix H I. These last are under the Sanitary Commissioner of British Burma, whose report forms Appendix H. All these have been inspected by the Sanitary Commissioner, who reports that at Bassein, Moulmein, and Mergui all the instruments were found to be in good order, and also reports favourably of the observers generally. The observatory of Toungoo was removed to a different site on the 1st May. The barometric registers of this station after correction for the change of elevation are found not to be comparable with those of previous years, but this may be due to some uneliminated error affecting those of past years.

As far as can be judged from the registers, the work of the Burma observatories generally has been more satisfactory during the past year, and Mr. Pedler reports to a similar effect in the case of Akyab.

A special allowance of **₹5** has been continued to the Moulmein observer, Mr. P. H. Hilbert, for the current year.

OBSERVATORIES AT THE BAY ISLANDS.—The observatories of Port Blair and Nancowry have worked satisfactorily during the past year; and a special allowance of **₹5** has been continued to Mr. J. F. Peters, the observer at the former station. The names of the superintendents and observers are given in Appendix E.

EXTRA INDIAN OBSERVATORIES.—Eight of these were enumerated in the report for last year. But that of the Seychelles has ceased to contribute any register since January 1884, and owing to the transfer of the Political Agency of Zanzibar to the Home Government, and the consequent withdrawal of the Indian medical establishment, the work of the observatory at that station became irregular, and finally ceased in December 1884. This occurred on the death of the Agency Surgeon Mr. Williams, who, for some months after the withdrawal of the native observer, had carried on the observations with such regularity as was practicable. The loss of this observatory is much to be regretted, chiefly on account of the information it afforded respecting the meteorological condition of that part of the Indian Ocean.

The observatories of Aden and Bushire have continued to furnish very satisfactory registers, and these, together with the abstract of the Mauritius observations, for which I am indebted to Mr. Meldrum, F.R.S., the Director of the Royal Alfred observatory, are now the only data received from stations distant from India (except such as reach us in a published form, more or less after date). The observatory at Amini Divi in the Lakshadives has been re-established, but owing to the difficulty of communication with the island during the monsoon, the registers from April to November did not reach the Madras office until January 1885. This delay must in any case very seriously detract from their utility. They are, however, reported to be of a satisfactory character. A further drawback is that, owing to the departure of the observer and his temporary return to India, they have been again interrupted from the 26th December 1884 to the 22nd April 1885, an interval of four months.

The Leh observatory has furnished excellent work during the past year, under the immediate supervision of Sergeant Rowland, the actinometric observer. It has been transferred from the administration of the Punjab Reporter to that of the Central Office. The Quetta observatory has worked satisfactorily, and the information furnished by it has become of much importance in connection with the increase of the military establishments in Beluchistan. It will probably be found desirable shortly to extend the system of meteorological observation on this frontier.

The Katmandu observatory has been less satisfactory, and owing to the residency being under reconstruction, the barometric registers have been discontinued during the year.

INSTRUMENTS.

In Appendix I is given a return of the instruments in store at the beginning of the year, and of those received and issued by the Calcutta Meteorological Office, and includes the stock, receipts, and issues of the Alipore observatory; and in Appendix K is a return of the instruments issued to each observatory. In this are incorporated the returns furnished by the local Reporters.

METEOROLOGICAL OFFICES AND OFFICE WORK.

The general administration of the meteorological observatories and offices in the

different provinces, with the local exceptions noticed in the foregoing sections, has been in the hands of the following officers during the year :—

Name.	Office.	Province.
H. F. Blanford, F.R.S. . . .	Meteorological Reporter to the Government of India	} Central Office.
W. L. Dallas, Esq. . . .	Assistant Meteorological Reporter to the Government of India	
John Eliot, M.A. . . .	} Meteorological Reporter to the Government of Bengal	} Bengal and Assam.
A. Pedler, Esq. (Offg.). . .		
Dr. Murray Thomson (Offg.)	} Meteorological Reporter to the Government of the North-Western Provinces and Oudh . . .	} North-Western Provinces, Oudh, Rajputana and Central India (part).
S. A. Hill, B.Sc. . . .		
Dr. E. Lawrie	Meteorological Reporter, Government of Punjab .	Punjab.
A. N. Pearson, Esq. (Offg.) .	} Meteorological Reporter for Western India . . .	} Bombay, Berar, Rajputana and Central India (part).
F. Chambers, Esq. . . .		
Miss Isis Pogson	Meteorological Reporter, Government of Madras .	Madras, Mysore, Coorg and Hyderabad.
Dr. J. H. Loch	Sanitary Commissioner, Central Provinces . .	Central Provinces.
Dr. Little	Sanitary Commissioner, Berar	Berar.
Dr. D. Sinclair	Sanitary Commissioner, British Burma . . .	Burma.
Surgeon-Major J. Reid . .	} Senior Medical Officer, Bay Settlements . . .	} Andamans and Nicobars.
„ „ W. N. Keefer . . .		

I was absent on privilege leave from the 10th December 1884 to the 10th March 1885, during which Mr. S. A. Hill officiated as Meteorological Reporter to the Government of India in addition to his own special duties.

Mr. John Eliot took leave on furlough on the 9th December 1884, since which time Mr. A. Pedler has officiated as Meteorological Reporter to the Government of Bengal.

Mr. S. A. Hill returned from furlough and resumed charge of his office as Meteorological Reporter to the Government of the North-Western Provinces and Oudh on the 21st October 1884, up to which time Dr. Murray Thomson had officiated from the beginning of the year.

Mr. A. N. Pearson continued to officiate as Meteorological Reporter for Western India up to the 10th November 1884, on which date he was relieved by Mr. F. Chambers, who resumed charge of his office.

In the Punjab and Madras the permanent incumbents remained in charge of their respective offices during the whole of the year under report.

Mr. Dallas, Assistant Meteorological Reporter to the Government of India, took his departure on privilege leave on the 31st March 1885, one day before the close of the year.

The following table shows the number of stations, the registers of which were sent to

each of the Reporters respectively for reduction and verification during the year under report:—

PROVINCES.	METEOROLOGICAL REPORTERS.						TOTAL.
	India.	Bengal.	North-Western Provinces and Oudh.	Punjab.	Western India.	Madras.	
Bengal and Assam	4	19	...	...	...	...	23
North-Western Provinces and Oudh	2	...	14	...	...	...	16
Punjab	2	...	...	11	...	...	13
Rajputana and Central India	1	...	4	...	4	...	9
Central Provinces	11	...	...	...	...	...	11
Berar	1	...	...	...	4	...	5
Bombay . . . . .	...	...	...	...	13	...	13
Madras, Mysore, and Coorg	1	1	...	...	...	16	18
Burma	7	1	...	...	...	...	8
Bay Islands	2	...	...	...	...	...	2
Extra Indian	5	...	...	...	1	1	7
TOTAL	36	21	18	11	22	17	125

This list does not include the registers of the provincial observatories in Bengal, nor those of Colaba observatory, Bombay, Goa, and Jeypore which are furnished to the Meteorological Office with all the necessary reductions.

In Bengal, the North-Western Provinces, and Bombay (in part), the reporters superintend the rainfall registers of the district and sub-divisional stations of their respective provinces, and prepare weekly and monthly returns of the rainfall, *viz.*:—

Bengal	172 ¹
North-Western Provinces and Oudh	253
Bombay	400?

During the past year, steps have been taken considerably to extend the rainfall registration in Bengal. It has been pointed out, by Mr. Pedler, that certain parts of the province, more particularly Chutia Nagpur, are very inadequately represented by the existing rainfall registers. In Chutia Nagpur, nearly 27,000 square miles of country are represented by only 11 rain-gauge stations. It has, therefore, been proposed to establish 72 additional stations, making a total of 244, and this proposal has been sanctioned and put in execution since the beginning of the current year.

Mr. Hill has undertaken a comparison of the registers, obtained hitherto at the sudder stations of the North-Western Provinces, with the old Fleming (float) gauges and the more trustworthy Symons's (measure glass) gauges supplied two years since. He finds that while, at about half the stations, the returns furnished by the old gauges are fairly accurate, at some of the others the error amounts to as much as 20 per cent.; also that, on the whole, the proportion of erroneous gauges in the North-Western Provinces is less than in Oudh. The published charts of rainfall for the North-Western Provinces, which have been drawn up in a great measure from the data furnished by the old gauges, show therefore not a few errors of detail.

¹ 156 excluding stations at which observatories also exist.

In Madras, the Revenue rain-gauge stations are not at present under the administration of the Meteorological Office, but the Reporter mentions that it is in contemplation to effect their transfer at an early date.

The Reporters for Bengal and Western India also administer a system of storm warnings for the protection of the local ports, and the Bengal Reporter has in addition the working of a system of daily telegraphic weather reports from the 15th May to the 15th November. He also collects the meteorological observations from the log-books of ships entering the port of Calcutta.

Mr. Dallas, Assistant Meteorological Reporter to the Government of India, has been in charge of the Imperial system of daily weather reports up to the 30th March, when he took privilege leave. He also prepared monthly and semi-annual summaries of the weather reports, and has continued the reduction of the marine observations received from the London Meteorological Office and the preparation of charts of the Bay of Bengal, showing the distribution of barometric pressure, the prevalent winds, and marine currents in each month of the year. These are now complete, and he is proceeding with the preparation of similar charts for the Arabian Sea and those of the density of the seawater in the Bay of Bengal. The charts showing the distribution of air temperature and the temperature of the sea will be deferred until the more important series of charts are completed for the whole area.

With a view to relieving Mr. Dallas of some of the more mechanical duties connected with his work, it was proposed, during the past year, to train an educated native to prepare the daily weather reports and charts; and after some enquiry from the principals of the chief colleges of Upper India, a competent candidate Ruchi Ram Sahni, M.A., was selected on the recommendation of the Principal of the Lahore College and appointed on probation on the 10th January 1885. Some time before Mr. Dallas's departure on leave, he had practised the work of the daily reports under Mr. Dallas's supervision, and afterwards under my own, and he now gives good assistance in this part of the office work.

OFFICE ESTABLISHMENT.—The following is a return of the number of permanent employés (ministerial officers and menials) in the offices of the several Meteorological Reporters:—

	India.	Bengal.	North-Western Provinces.	Punjab.	Western India.	Madras.	TOTAL.
Head Clerks	1	1	1	1	1	1	6
Computers	3	...	...	...	1	...	4
Clerks and Copyists	3	2	1	2	...	3	11
Tabulators	18 ¹	7	4	...	5	...	34
Draughtsmen	3 ²	1	...	...	...	...	4
Artisans . . . . .	...	3	...	...	...	...	3
Peons and Menials	10	4	2	1	2	1	20

¹ Besides these, there are four temporary clerks for reducing the London Meteorological Office marine logs.

² Besides these, there is one temporary draughtsman for drawing up marine charts.

The Central Office has remained under the charge of the Head Clerk, Babu Fanindra Mohun Basu, and has been conducted in a most satisfactory manner. I have recommended that, in consideration of the large amount of responsible work which devolves on this officer, and also of the excellent manner in which he has managed the office for many years past, the salary of his appointment should be raised.

The Head Computer, Babu Nirduksha Kumar Ghosh, deserves mention for his careful superintendence of the computing work of the office; and as his duties demand an acquaintance with advanced mathematics, I have recommended that his appointment also be placed on a better footing. These recommendations have been conditionally approved, and, together with some other recommendations for the improvement and strengthening of my own and the provincial offices, will, I anticipate, take effect as soon as financial considerations will admit of them.

The Reporters for Bengal, the North-Western Provinces and Oudh, and the Punjab speak in favourable terms of the conduct of their respective establishments.

The Madras Meteorological Office has now been entirely removed from the observatory, of which at one time it formed an integral part. This office as well as that of the Reporter for the Punjab and that of the Reporter for Western India require strengthening, and I am in hopes that this may be effected during the current year.

WEATHER BULLETINS AND STORM SIGNAL SERVICE.—The daily weather reports of the Imperial Office were issued at Simla from the 1st May to the 31st October, and from Calcutta during the remainder of the year. Arrangements have been made to carry on this work permanently at Simla in future, and an establishment of Punjabi clerks has been partly formed for the purpose, a corresponding reduction being made in the establishment of the Calcutta Office. The weather reports are issued in the same form as in the previous year. The verbal summary, which accompanies each issue, is telegraphed to all the Provincial Governments, and copies are furnished to the daily newspapers at Calcutta, Allahabad, and Bombay.

As a part of the work connected with the daily reports, notice is sent by urgent telegram to the Meteorological Office, Bombay, of the progress of any storms that advance from the Bay of Bengal towards the western presidency; and arrangements were made during the past year, in correspondence with the Government of Bombay, for sending notice by urgent telegram to the Civil and Political Officers of Khandesh and Guzerat of the appearance of storms that are likely to produce floods in the Tapti and Nerbudda; also for telegraphing direct to the same officers, from certain observatories in the upper drainage basins of these rivers, the occurrence of heavy rain, in order to give them due warning of probable floods. These arrangements have been in operation during the present monsoon.

In Bengal, the daily weather report for the province, containing telegraphic reports from 32 stations together with a verbal summary, was issued regularly from the 16th May to the 7th November, and Mr. Pedler reports that it is becoming appreciated by the general public, as is manifested by a considerable increase in the number of subscribers. In addition to these, daily reports of the weather at 19 stations round the coasts of the Bay are issued with a weather chart, the form and appearance of which has been much improved. This is printed daily in the Meteorological Office and is issued to 27 subscribers and to 37 Government officers.

The storm signals have been worked as in former years. No very severe cyclone occurred in the Bay of Bengal during the year, but a number of small cyclonic storms were formed during the monsoon, chiefly at the head of the Bay, and advanced different distances across the land. Of these there were two in June, six in July, two in August, four in September, and two in October. Most of these were of small intensity, and the storm signals were hoisted only on two occasions.

In Bombay, the storm signal service has been carried on as in previous years. But this coast, like the Burmese coast of the Bay of Bengal, is but rarely visited by cyclonic storms, and there has not been occasion to hoist the signals once during the year. No daily weather reports are published by the Bombay Office.

WEEKLY, MONTHLY, AND SEMI-ANNUAL REPORTS.—From May to October inclusive, a monthly descriptive summary of the chief weather characteristics of the month, based on the telegraphic reports, was prepared in the Simla Office and published in the Gazette; and from November 1884 to April 1885, a similar report was prepared in alternate months. In May and November, a general review of the weather of the preceding half-year was drawn up and published in like manner.

In addition to the above periodical reports, special reports were drawn up in May and June on the Himalayan snowfall of the preceding winter and spring, and on the strength of these reports an attempt was made, as in the previous year, to forecast the character of the monsoon rains. The result has already been noticed in Part II of this report, and for a second time has justified the terms of the prognosis. During the present year, success has been still more marked, and the experience has very greatly confirmed public confidence in the justice and validity of the views on which these forecasts are based.

Charts showing the average distribution of the rainfall of India in the three seasons, the cold season (November to February), the hot season (March to May), and the rainy season (June to October), have been prepared, and several copies furnished to Government. Also charts on a similar plan and scale, showing the actual distribution of the rainfall in the corresponding seasons of the past year, have been prepared and submitted in like manner, but these are not published.

Weekly and monthly meteorological and rainfall reports of the province are drawn up by the Bengal Reporter, and published in the *Calcutta Gazette*; and during the monsoon, four sets of three rainfall charts of the province, showing the distribution of the rainfall and its variation from the average, are prepared for the Local Government.

In the North-Western Provinces and Bombay, abstracts of the meteorological observations and of the rainfall have been published in the local Gazette as in previous years.

ANNUAL REPORTS.—The report on the meteorology of the year 1883 was complete and in the printer's hands, by the beginning of December, and the printed report was submitted to Government on the 1st June 1885. As is usually the case, the text was completed several weeks in anticipation of the plates.

The report gives tables of temperature for 134 stations and rainfall returns of 462 stations, being an increase of four of the former and five of the latter on the numbers respectively given in the report for 1882. The returns of most other meteorological elements

are nearly as numerous as those of temperature. The elements tabulated in the Appendix are as follow. For comparison I give similar tables for the last five years.

	NUMBER OF STATIONS.					
	1878.	1879.	1880.	1881.	1882.	1883.
Equilibrium temperatures of solar radiation	99	106	109	106	112	111
Duration of bright sunshine . . . . .	...	...	...	...	...	2
Temperatures of nocturnal radiation	97	100	108	106	104	107
Temperatures of the ground . . . . .	...	...	2	4	4	4
Mean and extreme air temperatures	116	123	126	131	130	134
Sea-level equivalents of mean temperatures	100	101	105	108	108	111
Means and extremes of atmospheric pressure	113	119	122	125	124	125
Sea-level equivalents of mean atmospheric pressure	96	98	105	107	108	109
Direction and movement of winds	113	118	124	127	125	127
Temperature of evaporation	106	111	115	121	120	124
Tension of atmospheric vapour	113	120	123	128	127	130
Mean relative humidity	114	120	123	128	127	130
Mean proportion of clouded sky	110	118	122	125	124	127
Inches of rainfall in each month	253	365	399	417	457	462
Number of days on which rainfall was measured	276	365	379	403	457	462

The descriptive letter press discusses the chief characteristics of the meteorology of the year. It includes tables of the average values of all the more important meteorological elements for all stations that have furnished returns for three years and upwards, and the report is illustrated with nine plates, *viz.*, a chart showing the position of all observatories and rain-gauge stations; three in coloured lithography, representing the mean distribution of temperature, pressure, and winds in each month of the year; and five illustrating certain cases of rainfall in the cold weather, the weather during a period of excessive drought in May, and also that of the rainy period which followed; the setting in of the rains in Bengal, and the simultaneous formation of two independent storms in November, in North-Western India, and in the Andaman Sea.

The original observations of six observatories, *viz.*, Calcutta, Lucknow, Lahore, Nagpur, Bombay, and Madras, were issued in a distinct publication in monthly parts. Those forming the volume for 1883 were completed in May 1884, and those for 1884 in July 1885.

MISCELLANEOUS PUBLICATIONS.—Part III of the second volume of the Indian Meteorological Memoirs, containing a very carefully worked out memoir by Mr. Eliot, on the storm of the 8th and 9th October 1882, in the Bay of Bengal, was issued in November 1884. Part IV containing another long and elaborate memoir, also by Mr. Eliot, on the storms of the Bay of Bengal during the years 1877 to 1881, was printed and nearly ready for issue at the close of the year, and part V which will conclude the volume is now nearly ready for issue. This contains a paper by Mr. S. A. Hill, on observations of temperature and humidity, at 4 and 40 feet above the ground surface, made during three years at Alipore; and also the general index to the volume.

Other memoirs now in the press, or in hand and shortly to be sent to press, are, a memoir on the rainfall of India, which with plates and tables will form Volume III; a memoir by Mr. Eliot on the Akyab cyclone of May 1884; and a short paper by Mr. W. L. Dallas on the meteorology of the southern central portion of the Bay of Bengal. These two papers will form the first part of Volume IV.

A paper on the "Theory of the Winter Rains of Northern India" was published in No. 1, Part II of the Journal of the Asiatic Society of Bengal for 1884; and an "Account of the south-west monsoon storms of June, July, and November 1883" by Mr. Eliot in No. 2 of the same part and volume. A paper by Mr. S. A. Hill on "Observations of the solar thermometer at Lucknow" was also communicated to the Asiatic Society of Bengal and published in No. 1, Part II of the Society's Journal for 1885. Mr. Pearson, when officiating as Reporter for Western India, contributed to the proceedings of the same Society a note on the variations of the rainfall of Northern India, and Mr. F. Chambers, a short note, of controversial character, on one of the above papers.

In addition to the above, a paper by myself "On the connection of the Himalayan snowfall with dry winds and seasons of drought in India" was published in the proceedings of the Royal Society for May 1884, and Mr. Pearson contributed to the Royal Meteorological Society of London a paper entitled "Some results of an examination of the barometric variations in Western India" and a description of a new component anemograph invented by himself. The former was published in the Society's Journal for October 1884; the latter given in abstract in the January number for 1885.

Although not the work of an officer of the department, I may also mention as being in part the outcome of the work of the department, a very interesting paper by Dr. D. Brandis, late Inspector General of Forests in India "Die Beziehungen zwischen Regenfall und Wald in Indien," communicated to the "Niederrheinische Gesellschaft für Natur und Heil-kunde" at Bonn, at a meeting at which I was present in January last. This has since been published in the proceedings of the Society.

Appendix L gives a list of the Government officials, libraries, observatories, societies, &c., to which the publications of the office are presented including those which send their own publications in exchange.

LIBRARY.

Since the transfer of the Calcutta Meteorological Office to a larger building, it has been possible to devote a room to the large and increasing library which has hitherto

been scattered through the office. New book-cases have been provided, and it will be possible now to re-arrange the library in such manner as to make it readily accessible for reference, provided, that is to say, the office remains in its present commodious quarters. Until this point shall be decided, it will be of little use to undertake its re-arrangement.

A list of the additions to the library is given in Appendix M.

HENRY F. BLANFORD,

Meteorological Reporter to the Government of India.

SIMLA :

The 17th August 1885.

APPENDIX A.

Extracts from the Administration Report of the Meteorological Reporter to the Government of Bengal for the year 1884-85.

The Bengal Meteorological Department was under the control of the permanent head of the department, Mr. John Eliot, from the beginning of the official year until the 9th of December 1884, when Mr. Eliot proceeded on furlough. From this date till the close of the official year the department has been under my charge.

During the year under review, the extended scheme of meteorological observation, and the special arrangements for the speedy transmission of the meteorological and rainfall observations taken throughout the province, together with their speedy reduction, collation and publication through the various publications of this office, which were sanctioned in the year 1882-83 and brought into action in 1883-84, have been carried out steadily. The details as to the extent and nature of the observations which are now made, together with the method of collection of the returns, and the manner in which such returns are utilized for the information of Government and for subsequent publication, have already been fully described, first, in the form of proposals in the Administration Report of 1882-83; and secondly, in the Administration Report of 1883-84, where a full description was given of the arrangements which had been made to carry out the wishes of the Bengal Government in this matter.

During the year there has been no change or addition to the number of the regularly constituted observatories in Bengal and Assam of the second and third classes. There was only an addition of one observatory to the list of provincial third class stations, *viz.*, Bogra, which was started from the 2nd December 1884. The total number of stations thus reporting to the Bengal Meteorological office during the year were seven second class, fifteen third class, and twenty-three provincial third class observatories.

Sanction was given to the establishment of observatories at three other stations during the year, *viz.*, one at Tezapore in Assam, which is to be an imperial third class observatory, and two other provincial third class stations at Kishnaghur and Maldah in Bengal. But owing to difficulties in the selection of suitable sites for the observatories and to other delays, they could not be started within the official year. In the case of Tezpur and Kishnaghur, Mr. Eliot found it necessary personally to visit the stations for the selection of the sites for the respective observatories. The Magistrate of Bankoora (Mr. Anderson) proposed to start a voluntary observatory at his station, which would furnish observations for the Bengal daily weather report, and sanction was given to this proposal by the Meteorological Reporter to the Government of India in August 1884. A shed was provided by this department, and it is hoped that the observations which will be received will be useful to give indications of the weather over a large area which is practically now unrepresented by any regular station, except distantly by Raneeunge.

Second class observatories.—These are seven in number. Five are in Bengal and the remaining two in Assam. The names of the superintendents and observers at these stations are given in the following table:—

Second Class Stations.

STATIONS.	Superintendents.	Superintendents' allowances.	Observers.	Observers' allowances.	Assistant observers.	Assistant observers' allowances.
Sibsagar {	Dr. T. D. O. Partridge ¹	R 30	Babu Dandadhur Dutt Borua. ²	R 30	Babu Ratneswar Gogoi.	R 10
	„ C. J. Atkins. ²					

¹ From 1st April 1884 to 17th February 1885.² From 18th February to 31st March 1885.³ Received special allowance of R10 per month for meritorious services.

Second Class Stations—contd.

STATIONS.	Superintendents.	Superintendents' allowances.	Observers.	Observers' allowances.	Assistant observers.	Assistant observers' allowances.
		R		R		R
Dhubri .	Dr. Edwin Dobson .	30	Munshi Maniruddeen Ahmed. ¹ Munshi Kadimuddeen Ahmed. ²	30	Babu Ambica Prosad Dey.	10
Hazaribagh .	„ R. Cobb ³ . „ J. Wilson ⁴ . Babu T.C. Das. ⁵ Dr. C. J. W. Meadows. ⁶	30	Babu Nathoolal* .	30	Babu Dwarknath .	10
Bankipore .	Dr. J. G. French ⁷ . Baboo Ramkali Gupto. ⁸ Dr. W. A. Gilligan. ⁹	30	Munshi Mohubbut Lal.	30	Babu Muddun Mohun Lal.	10
Saugor Island .	.....	.....	Mr. J. A. Thomas	45	Nil.	Nil.
Cuttack .	.....	.....	„ H. W. Alley*	32	Mr. B. Sebastian .	13
Chittagong .	.....	.....	„ P. O. Pereira „ J. E. Gabriel .	30	Mr. J. Dias „ E. J. J. Tixura. }	15

¹ Died on 2nd November 1884.² From 1st November 1884 to 31st March 1885.³ From 1st April 1884 to 7th July, and 8th August to 3rd February 1885.⁴ From 8th July 1884 to 7th August 1884.⁵ From 4th to 10th February 1885.⁶ From 11th February 1885 to 31st March 1885.⁷ From 1st April 1884 to 5th August 1884, and 6th September 1884 to 31st March 1885.⁸ From 6th August to 15th August 1884.⁹ From 16th August 1884 to 5th September 1884.

* Received special allowance of Rs 5 per month for good services.

Five of these observatories are provided with self-registering anemographs. The anemographs at Dhubri, Hazaribagh, and Cuttack are of the Casella pattern, which record the wind direction and amount at intervals of one hour. The remaining two stations, Saugor Island and Chittagong, are provided with Beckley's anemographs, which register wind direction and amount continuously. There were very few breaks exceeding 24 hours in the working of these self-recording instruments, and in the majority of instances the cause of them has been the necessity for cleaning and repairing the instruments, and there have been extremely few stoppages which could possibly have been avoided.

Two of these observatories were visited during the year, *viz.*, Hazaribagh and Cuttack, by my head clerk, who reported as follows:—

“The *Hazaribagh* observatory was inspected on the 26th October 1884. No change has been made in the position and exposure of the instruments since the last inspection of the observatory by

Mr. Eliot in December 1882. The observer was punctual in taking the observations, and, generally speaking, the condition of the observatory was fair, but there were some defects which call for notice.

"The anemograph was found to work smoothly, but the chain connecting the wind-vane to the recording part of the instrument was found to have lengthened slightly, and failed to secure a good hold of the cog-wheels for fixing the direction indicator on the dial of the instrument. One link was therefore taken off the chain to remove the defect, and the instrument worked more satisfactorily. The anemometer requires to be changed for a better one, as it works rather heavily.

"The pad of the grass minimum thermometer was in shreds. The grass minimum was being exposed on grass on earth. The observer should have reported these facts.

"I examined the observer and his assistant thoroughly, and found that both did well and read the instruments fairly. They make very few mistakes.

"The records of the observatory were all in confusion."

The observatory has continued to maintain a good character for correct and punctual submission of returns, but the inspection report shows that, though in fair working order, it was scarcely in such good condition as would have been the case had the observer taken a warm and intelligent interest in his work, and his personal allowance was only retained on his assurance to pay proper attention to his duties.

Cuttack observatory "was inspected on the 3rd February 1885. No change of importance has been made in the position of the shed or in the arrangement of the instruments since Mr. Eliot's inspection in January 1883. The thermometer shed required repairs. The instruments were clean and in very satisfactory condition. The observatory continues to maintain its high character, and is thoroughly satisfactory in its equipment and accurate and valuable in its observations. Mr. Alley, the observer, and his assistant, were examined, and both acquitted themselves well, and were correct and quick in their observations." The observatory has been provided with a lightning-conductor at the expense of the Meteorological Department for the protection of the wind instruments.

The Dhubri observatory shed was destroyed by fire on the 6th April 1884. Complete observations had therefore to be suspended from that time to the first week of November 1884, when a new shed was built and the observations resumed. Incomplete observations, however, were telegraphed to the Meteorological Reporter to the Government of India, giving the barometer readings and the wind and rain observations for the purposes of the India weather reports. Observer Maniruddin Ahmed, who was a recipient of a ten-rupee special allowance, was granted sick leave for six months from 6th May 1884, and as the full set of observations had to be suspended, it was not found necessary to arrange for another head observer, but the assistant observer carried on the partial observations necessary. Observer Maniruddin Ahmed died on the 2nd November 1884, and Kadimuddin Ahmed was appointed in his place on probation.

The rest of the observatories of the second class continued to furnish very satisfactory returns throughout the year. There have been very few breakages of the instruments in these stations. In some, however, old instruments have had to be replaced either for defect or for their being worn out by long use. At Cuttack the sun radiation thermometer was broken by a sudden hailstorm while under exposure. Owing to the breakage of this instrument, which had been always exposed on forked sticks according to the old plan, it was considered desirable, when a new instrument was supplied in May 1884, to bring its conditions of exposure into conformity with the standard regulations in the *vademecum* by providing the observatory with the usual stand for the exposure of the sun thermometers.

The readings of the Saugor Island barometer had to be rejected for the period 8th February to 15th March 1885, consequent on the instrument having become useless by leakage of the mercury from the cistern. It was replaced by a new instrument with the least possible delay.

It will thus be seen that, on the whole, the work at the second class stations has been very satisfactorily performed, and that it has been fully equal to that of former years. The returns have been punctually submitted, and there have been few, if any, causes of complaint in the working of these stations.

Imperial third class observatories.—These are fifteen in number. Ten are situated in Bengal, one, Akyab, in Burma; two, Silchar and Tura, (voluntary observatory) in Assam; and two, Gopalpore and Coconada, in Madras. The two last are maintained in connection with the Bay of Bengal storm signal service.

The following table gives the names of the superintendents and observers at these observatories during the year 1884-85 :—

STATIONS.	Superintendents.	Observers.	Observers' allowances.
Darjeeling, St. Paul's School.	R. Carter, Esq., Rector, St. Paul's School, Darjeeling.	Mr. W. Moore	R 25
Purneah	D. Picachy, Esq.	Rajani Kant Chackervarti	15
Durbhanga	{ W. A. Gilligan, Esq. ¹ Nobin Chunder Dutt ² W. A. Gilligan, Esq. ³ J. C. Shaw, Esq. ⁴ }	{ Jogin Chandra Banerjee }	Nil.
Gya	Dr. R. Macleod, M.D.	Nowrungee Lall	15
Berhampore	{ Dr. S. M. Shircore ⁵ „ Beny Madhub Bose }	{ Mahendra Nath Roy* }	15
Burdwan	{ Dr. R. D. Murray ⁷ „ H. B. Purves ⁸ }	{ Mokhoda Prosad Chowdhry** ⁹ Makhon Lall Chowdhry ¹⁰ Haroo Shaikh ¹¹ }	15
Jessore	{ Dr. D. W. D. Comins ¹² „ R. D. Murray ¹³ „ W. Beatson ¹⁴ „ J. B. Gibbons ¹⁵ „ W. Beatson ¹⁶ }	{ Paresh Nath Roy Chowdhry }	15
Dacca	Nil	Mr. T. W. deSouza	15
Silchar	{ Dr. J. J. Monteath ¹⁷ „ H. C. Banerji ¹⁸ „ T. d'O. Partridge ¹⁹ }	{ Romesh Chandra Bhadro }	15
Demagiri	Nil	{ Surjya Kumar Ghosh ²⁰ Girish Chandra Bhar ²¹ Rajany Kanta Bose ²² Girish Chandra Bhar ²³ }	Nil.
False Point	Nil	Mr. E. Workman (assisted by Mr. J. London).	25
Akyab	Nil	{ Mr. H. J. Smythe ²⁴ „ E. B. Atkinson ²⁵ }	15
Tura	{ Dr. J. McNaught ²⁶ „ P. M. Gupta ²⁷ }	{ Abdul Majeem }	{ Voluntary station.
Gopalpur	{ Captain A. L. Taylor ²⁸ Mr. M. Broom ²⁹ Captain J. H. Fletcher ³⁰ }	{ Goona Appalananarsimhum }	15
Coconada	Port Officer	Mr. C. J. M. Gaëtane	15

¹ 1st April to 15th August 1884.

² 16th August to 7th September 1884.

³ 8th to 16th September 1884.

⁴ 17th September 1884 to 31st March 1885.

⁵ 1st April 1884 to 21st March 1885.

⁶ 22nd to 31st March 1885.

⁷ 1st to 13th April 1884.

⁸ 14th April 1884 to 31st March 1885.

⁹ 1st April 1884 to 8th January 1885 and 20th February 1885 to 31st March 1885.

¹⁰ 9th January 1885 to 6th February 1885.

¹¹ 7th to 19th February 1885.

¹² 1st to 18th April 1884.

¹³ 19th April to 2nd July 1884.

¹⁴ 3rd July to 5th October 1884.

¹⁵ 6th October to 4th November 1884.

¹⁶ 5th November 1884 to 31st March 1885.

¹⁷ 1st April to 11th November 1884.

¹⁸ 12th November 1884 to 18th March 1885.

¹⁹ 19th March to 31st March 1885.

²⁰ 1st April to 23rd September 1884.

²¹ 24th September 1884 to 31st January 1885.

²² 1st February to 16th March 1885.

²³ 17th March to 31st March 1885.

²⁴ 1st April to 13th May 1884.

²⁵ 14th May 1884 to 31st March 1885.

²⁶ 1st April 1884 to 2nd February 1885.

²⁷ 3rd February to 31st March 1885.

²⁸ 1st April to 21st August 1884.

²⁹ 23rd August to 16th November 1884.

³⁰ 17th November 1884 to 31st March 1885.

* Received a special allowance of Rs 10 a month for meritorious service.

Of the third class observatories very few required inspection. Five stations only were visited during the year—Darjeeling, Durbhanga, and Jessore by Mr. Eliot, and Gya and False Point by my head clerk.

The Casella anemograph, provided in 1882 for the Darjeeling observatory, having failed to give workable anemograms, particularly during the cold weather months, notwithstanding that the observer, Mr. Moore, and the Superintendent, Mr. Carter, had devoted much time and skill in endeavouring to make the instrument work satisfactorily, Mr. Eliot thought it desirable to personally inspect its working at a period when it usually gave bad results, and he therefore visited the station in November 1884, and after a careful examination of the instrument recorded his opinion that it would never work satisfactorily, and he desired that it should be dismantled and replaced by a self-registering anemograph of Beckley's pattern. An instrument of this description was therefore put in order, and was sent up early in March, and I was able to visit the station during the latter end of March 1885 to superintend its erection and starting. The Beckley's anemograph has now been set up, in a substantial manner, on the roof of a small house at the summit of Mount Vernon, the elevation of which is 7,599 feet. The anemograph is in a thoroughly satisfactory position as to exposure, and the instrument is one which always yields excellent results; and under the careful supervision of Messrs. Carter and Moore, it is to be expected that very valuable records will be obtained of the movements of the upper strata of the atmosphere, which will increase our knowledge of this branch of Indian meteorology in a manner hitherto unattainable.

The Berhampur observatory under Babu Mahendra Nath Roy and the Burdwan observatory under Babu Mokshoda Prosad Roy Chowdhury have continued to work in a highly satisfactory manner, and these observers have well maintained their previous reputation.

The Jessore observatory having improved very materially in its condition and in the character of its observations, the observer, Babu Paresh Nath Roy Chowdhury, has been recommended for a personal allowance of Rs 5 per month. Hitherto the thermometers in the observatory were exposed in a wooden cage of the old pattern, but this has been replaced by a cage similar to those now used in our other observatories.

Gya observatory ceased to be furnished with radiation thermometers from 1882 by order of the Meteorological Reporter to the Government of India, as the breakages of these fragile instruments were more numerous than at other stations. I regret to have to report that there has been little or no improvement in the accuracy of the returns received from Gya. Mr. Eliot, in the Administration Report for 1883-84, hinted at the worthlessness of the minimum thermometer readings. He suspended the meteorological allowance of the Gya observer from 1st April 1884 for wrong readings of the minimum thermometer and for his not taking due precautions to find out the cause or source of the errors which had been pointed out to him more than once. A new minimum thermometer was then sent to the Gya observatory to replace the old instrument, in order to see if the defective readings were due to a bad thermometer, but the observer continued to give the readings from the indications of the old instrument. Another fresh cause of complaint was found in the readings of the anemometer. The observer was telegraphing wrong wind velocities, notwithstanding that his attention had been repeatedly called to the fact. Thereupon the office head clerk was deputed, in November 1884, to investigate into the cause of these erroneous readings, and he reported that he found the minimum thermometer which had been sent had remained in store with the spirit column broken, and that no report of the fact had been ever made, nor was the instrument ever used. The head clerk examined the old minimum thermometer and found it to be in good order, and this confirmed the belief that the observer had neglected his duties, and the wrong readings were mainly due to his want of attention to the regulations for reading the instrument. It had been the intention to take comparative readings, but this object was frustrated by the observer not bringing the new instrument into use, or reporting it as out of order, when a fresh thermometer could have been sent. The defect in the wind velocity readings was due to the observer's incorrect method of calculation in finding out the appropriate word from the code to telegraph his results. For these faults the observer was fined two months' pay. The observer, however, has since improved in his readings of the barometer, and it is hoped he will continue to furnish satisfactory readings of the rest of the instruments. If the observer fails in his duty in this respect, it will be a matter of question whether some other agency than the Civil Surgeon's clerk should not be sought for to carry on the duties of the observer.

The Akyab observatory has improved considerably in the character of its observations. The observer, however, had to be fined Rs 10, in June 1884, for having broken a grass radiation

thermometer by plunging it into warm water. He had taken this step on the supposition that it would unite the broken column of spirit in the thermometer.

Having regard to the frequent breakage of nocturnal radiation thermometers at Cachar, the issue of these fragile instruments has been prohibited by the Meteorological Reporter to the Government of India, in accordance with the terms of his office circular No. 1, dated 3rd April 1882, with effect from November 1884.

Generally speaking, the returns from the rest of the observatories of the third class were satisfactory. The following are the reports of inspection of some of the observatories. Of the five observatories inspected, three, *viz.*, Darjeeling, Jessore, and Durbhanga, were visited by the Reporter, and two, *viz.*, Gya and False Point, by my head clerk.

Darjeeling was visited on the 28th November 1884. The barometer and thermometers were all in good order, except the dry minimum, in which a small portion of the column was detached. Instructions were given as to the method to remedy this permanently; but if the defect continues, it would be desirable to supply another instrument.

Jessore observatory was inspected on the 2nd December 1884. The barometer was in good order. The thermometer shed is not in a very satisfactory position, being much shut in. The instruments are all in good order. A slight encrustation was found on the wet bulb thermometer, and the observer was instructed to remove it in future. The solar radiation thermometer has a small portion of mercury lodging at the extreme end of the tube, which the observer allows for in his readings (adding 1.2°). The wind-vane and anemometer were in good order. The latter was on a shaky wooden pillar which was ordered to be replaced by a brick pillar of same height.

The observer took the readings of the instruments readily and correctly. As his observations have been found to be very satisfactory, the observer has been recommended for ₹5 special allowance.

Durbhanga observatory was inspected on the 8th October 1884. It was found to be in much better condition than on any of my previous visits. The thermometers were clean and in good order. The anemometer was found to be working satisfactorily. The wind-vane is a very heavy one, and should be replaced by a lighter one.

Gya observatory was inspected on the 21st October 1884. The barometer was in the same position as on last inspection and perfectly clean. The observer read the instrument correctly.

The shed thermometers were found to be perfectly clean. The graduations on the maximum and the wet minimum thermometers were obliterated.

The anemometer was found to be perfectly clean and in good condition, but it required to be fixed firmly on to the wooden platform.

The thermometer cage was shaky and required to be made firm, as there was likelihood of the readings being disturbed by a gust of wind.

The thatching of the shed was good, but some of the posts have been eaten up badly by white-ants, and may with advantage be replaced.

False Point observatory was inspected on the 14th February 1885. It is situated on an open maidan outside the Light-house compound. The thermometer shed is enclosed by a fence of lattice work. The radiation thermometers are exposed within the enclosure on their proper stands. The observatory required thorough repairs. The fencing and the posts require to be looked after much oftener to prevent the white-ants from causing injury. All the wood-work should be completely tarred.

The barometer was in the same position as on last inspection. The instrument was in perfect order and clean. It was quite vertical.

The cage instruments were all in good order and perfectly clean. The observer reported to me that the grass thermometer gave him much trouble, as the spirit column was found to break very often. I found, on inspection, that a part of the spirit about 2° in length remained lodged at about an inch and a half from the top end of the tube, and the instructions in the *vade-mecum* failed to unite it with the main column. This instrument should be changed.

The sun thermometer was found to have a break in the mercury column below the index. The instrument is of the Phillip's principle. The break was not noticed by the observer, but was set right again with slight effort. The separation was but little.

The anemometer is placed on a pillar 20 feet high. The instrument worked well, but apparently with friction.

The rain-gauge was in good order.

During my visit the observer, Mr. Workman, was ill, and so I had to inspect the observatory with his assistant, who also takes the readings. Mr. London read the instruments quickly and correctly.

The observatory, generally speaking, appeared to be one of the best kept stations in Bengal, and its neat condition testifies to the amount of interest and care taken by the observer in his work.

It may therefore be stated that the majority of these third class observatories are satisfactory in character, and the observations which have been received from them have on the whole been very reliable.

* * * * *

Rain-recording Stations.—There has again been an increase in the number of rain-recording stations during the past year. The number of these stations during the past three years has been in 1882-83 162, in 1883-84 it was 167, and in 1884-85 it was 172. This increase is due to the establishment of the following rainfall stations in the Bancoora district :—

Indus, Kotulpore, Onda, Gangajalghatty, and Sonamukhi.

One station, however, *viz.*, Lalgola in the Moorshedabad district, has been suppressed at the latter end of March 1884, consequent on the abolition of the Government charitable dispensary, the rain-gauge having been in charge of the Assistant Surgeon. Efforts will, however, be made to re-establish it.

During the past year prominent attention was called to the fact that some parts of the province were very inadequately represented by rainfall-recording stations, and that Chutia Nagpur, in particular, only possessed 11 rain-gauges to represent no less than 26,966 square miles of country. To supplement the present registration system, and to extend the registration into districts which have hitherto been unrepresented, has been an urgent want of the department; and therefore, during the last part of the year, a scheme was drawn up, providing for no less than 72 additional rain-recording stations at an almost nominal cost to Government. The cost of nearly all the rain-gauges was met from the savings of this year's budget, and the annual cost will be simply the cost of the postage of the returns. With this extension, the system of registration will be fairly complete, and all parts of the province will be well represented. At the close of the official year the scheme was submitted to Government for sanction.

The returns from the great majority of the old recording stations were received punctually and regularly, and so far as can be judged, the registration of the rainfall is effected with fair accuracy and with considerable punctuality.

Instruments.—The following tables¹ show the number of instruments that have been broken or lost or rendered unserviceable during the year 1884-85 at the Imperial and Provincial observatories, and of the instruments supplied to them during the year. These tables show that the observers, on the whole, take great care in the use of the instruments committed to their charge, and the record may be looked upon as fairly satisfactory.

* * * * *

Office Establishment.—The office establishment on the 31st March 1885 consisted of the following clerks :—

Babu Chandi Charan Chatterjee,	Head clerk.
„ Purna Chandra Mukerjee,	2nd „
„ Nibarun Chandra Chatterjee,	3rd „
„ Kamini Mohan Bose,	Tabulator.*
„ Debendra Nath Banerjee,	„
„ Joggeswar Roy,	„
„ Bireswar Mukerjee,	„
„ Jati Lal De,	„
„ Rakhal Das Chackerbutty,	„
„ Ashutosh Roy Chowdhuri,	„
„ Hem Chandra Goswami,	„
„ Haridas Mazumdar,	„
„ Nagendra Nath Paul,	Draughtsman.

¹ The return of instruments issued has been incorporated in the general return in Appendix K.

The clerks generally have worked extremely well in dealing with the large amount of correspondence, and in the reduction and tabulation of the large number of observations now received, and with the preparation of reports which are required under the present system. The following are the regular reports and maps which are issued by the office :—

- (a) The Bengal daily weather report, from about 15th May to the 7th of November, and the Bay of Bengal weather report, throughout the year.
- (b) The weekly and monthly meteorological and rainfall reports for the province published in the *Calcutta Gazette*.
- (c) Four sets of three rainfall charts monthly during the south-west monsoon period, 1884 (*i.e.*, from May to November), showing by colours—
 - (1) The actual distribution of rainfall for the same month.
 - (2) The variation of the actual from the average rainfall, indicating whether it was in excess or in defect, and the amount of such excess or defect.
 - (3) The variation of the actual from the average expressed as a percentage of the normal fall.

The four sets were all drawn and coloured by hand. One set was forwarded about the 8th of the succeeding month (to that to which it referred) to His Honour the Lieutenant-Governor ; a second set to the Secretary to the Government of Bengal in the Revenue Department ; a third to the Sanitary Commissioner ; and the fourth was kept for office reference.

- (d) Sets of tables giving the average and actual rainfall, and the difference between the actual and average rainfall (or variation) for each month of the year 1884, and for the whole year at 170 rainfall recording stations. These returns were published in the *Calcutta Gazette* of the 4th February 1885.

In addition to these a series of special returns and a series of special maps were prepared illustrating the distribution of the rains in Bengal during the south-west monsoon period of 1884, *i.e.*, from 15th May to 15th November. A short account of the distribution of the rains was also prepared. These were submitted to the Secretary to the Government of Bengal in the Revenue Department, and the special returns, together with the meteorological summary of the rains, were published with the resolution of Government dealing with the agricultural condition and prospects of the crops which appeared in the *Gazette* of the 19th November 1884.

These various reports necessarily entail a large amount of continuous and rapid work on the part of the office, and I have to place on record my appreciation of the zealous and intelligent manner in which the head clerk, Babu Chandi Charan Chatterjee, has supervised the work of the office, and has also performed the work of inspection. Babu Kamini Mohan Bose, who is in charge of the rainfall statistics, and Babu Debendra Nath Banerjee, who is in charge of the daily reports, have also done excellent service during the past year, and have maintained their reputation as hard-working and assiduous clerks. The clerks generally have worked most satisfactorily, and have thus enabled the returns to be published punctually and without a break throughout the year.

Storm Signals.—No very severe cyclone was generated in the Bay of Bengal during the year 1884, but a number of small cyclonic storms occurred during the south-west monsoon period. As usual, these small storms gave rise to strong winds and rough seas where they were generated over the Bay, and they brought heavy rainfall in their advance inland. These storms have all been noticed, and their history briefly traced in the usual meteorological monthly summaries published in the *Calcutta Gazette*. Two small storms of this description were generated in June, both of which crossed the Balasore coast. In July six small storms were formed, five of which were generated over the sea, and of which three crossed the Balasore coast and two the Orissa coast between False Point and Gopalpore, while the sixth storm was generated over the land area, apparently in the Jessore district. In August, two small cyclonic storms were generated, the first of which crossed the Balasore coast, and the second the Ganjam coast near Gopalpur. In September four depressions were formed, two over the land area and two over the sea, of which one crossed the coast near Chandbali, and the second between Gopalpur and Vizagapatam. In October two depressions were formed, one of which formed over the land, and the second, which was a large and shallow depression, formed in the centre of the Bay and advanced up the Bay in a northerly direction into Bengal, giving very heavy rain in its

progress. Most of these storms, however, were of comparatively small intensity, and it was not thought necessary to hoist the storm signals, except on two occasions, the first being on June 19th, and the second on July 10th. The signal which was hoisted on each occasion was the same, and signified that a small cyclonic storm would pass between False Point and Saugor Island, and the signals remained hoisted for about 24 hours for each storm, and with their passage inland the signals were lowered.

Daily Weather Reports.—The new form of the Bay of Bengal weather reports of the storm signal service has been continued this year with but slight modification. The reports were issued in blue and black instead of entirely in black, and advantage was taken of the establishment of an observatory at Midnapore and direct telegraphic connection with Jessore to add two more stations to the number of the stations sending observations for this report. The report, last year, furnished observations taken at 19 stations against 17 in 1883-84. An observatory has also been established at Burrisal, and the observations from this station will form a valuable addition to the existing number of stations on or near the coast of the Bay which furnish observations for the report. This report was supplied to 27 subscribers and 37 Government officials at the end of the year. The receipts for subscriptions during the year covered the cost of printing and distributing the reports. There was a small balance of Rs 65-13-6 at the end of the year 1884-85, which was kept in hand in order to meet any repairs to the lithographic presses. The cost of printing the bi-color reports increased the expenditure on printing, and rather decreased the balance in hand during the year, but through the kind courtesy of Major Waterhouse the blue report forms are now being supplied to this Department from the Lithographic Branch of the Survey Department. Warm thanks are thus due to the Survey Department for assisting in the publication of these reports with neatness and despatch. The reports were published throughout the year without the break of a single day.

The Bengal daily weather reports, which were commenced in 1883, were published last year during the period May 16th to November 7th, 1884. The number of stations which furnished observations for this report during the year was 32, which is one in excess of the last year. These reports were published and issued by the Bengal Secretariat Press, and were supplied to 102 Government officials and to three subscribers. It appears, however, that the report is now appreciated by the mercantile community and by the general public, and it is hoped that the number of subscribers to the report will increase with each succeeding year. That such will be the case is probable from the fact that with the commencement of the 1885-86 reports no less than 15 new subscribers have registered their names. A little more practical value would probably be given to these Bengal weather reports, if the observations of the Assam stations could be included in them, and the meteorological condition of Assam and Bengal be discussed together in the review of the weather conditions daily, weekly, and monthly. But there are difficulties in the way of providing funds for the extra cost for the telegrams, &c., which may be necessary to give effect to these suggestions, and it is likely that the question may commend itself to the Assam Government for their consideration hereafter.

Copies of the weekly and monthly meteorological and rainfall returns (as published in the Gazette) were struck off for the convenience of the public, and were supplied at a charge just sufficient to cover the actual expense of printing and distribution.

Marine Meteorology—The working of this department for the year remained entirely in the hands of Mr. W. L. Dallas, the scientific assistant to the Meteorological Reporter to the Government of India, so that no details can be given in the Bengal Administration Report as to the amount of work done and progress made in this branch of meteorological research. The returns sent in to the Indian Meteorological Office are, however, placed at the disposal of the Bengal Reporter, and the information has proved of much value in the preparation of special reports and accounts of various storms, the formation and history of which have been worked out by Mr. Eliot, and accounts of which have been published from time to time.

During the year, an exceedingly valuable memoir was drawn up by Mr. Eliot on the south-west monsoon storms generated in the Bay of Bengal during the years 1877 to 1881, which has since been published as Volume II, Part IV of the Indian Meteorological Memoirs. Mr. Eliot also drew up an account of the south-west monsoon storms of the 26th of June to 11th of July and of 10th to 15th November 1883. This paper was published in the Journal of the Asiatic Society of Bengal, Volume 53, Part II. A third valuable paper was also drawn up by Mr. Eliot on the cyclone which passed inland near Akyab on the 17th of May 1884, but up to the present time this paper has not been published.

Expenditure—The following statement gives the expenditure on account of the Bengal Meteorological Department during the year 1884-85, and the total grants sanctioned by Government under each of the various heads:—

HEADS OF EXPENDITURE.	Actual expenses incurred during 1884-85.	Budget grant for 1884-85.
	R a. p.	R a. p.
Meteorological Reporter's allowance	5,400 0 0	5,400 0 0
Office establishment	5,903 8 11	6,060 0 0
Office rent	1,300 0 0	1,300 0 0
Observers { Telegraph masters, &c.	2,630 0 0	9,960 0 0
{ Native observers	3,750 0 0	
{ Provincial observers	2,680 0 0	
Messengers' allowances	171 0 0	171 0 0
Allowances to Superintendents of observatories	1,440 0 0	1,440 0 0
CENTRAL OFFICE.		
Contingent and office furniture	965 0 0	886 0 0
Purchase of rain-gauges for equipment of rain-recording stations under proposed extension.	840 0 0	.....
Postage	1,478 1 3	2,730 0 0
Telegraphic messages	15,694 0 0	19,150 0 0
Travelling allowances	1,346 10 0	1,030 0 0
OBSERVATORIES.		
Building and repairs	1,237 10 3	1,250 0 0
Contingent	75 13 6	98 0 0
TOTAL :	44,911 11 11	49,475 0 0

The expenditure of the department for the year 1884-85 has been considerably greater than in the year 1883-84, but this has been due to the fact that in the previous year, owing to unavoidable difficulties in starting the new scheme of provincial observatories, many of these did not commence work until the middle of June or beginning of July. The expenditure on observers' allowances, weather telegrams, &c., during the year 1883-84 therefore fell considerably short of the amounts which have been expended on these items during 1884-85, for the system has been practically in full working order during the whole of the year under review. The expenditure in the year 1884-85 has been ₹6,216-15-3 in excess of that of the previous year, and the main items of increased expenditure are those above alluded to. The expenditure has, however, been no less than ₹4,563-4-1 below the sanctioned budget grant for the year, but almost the whole of this difference is accounted for under the head of telegraphic messages or weather telegrams, and it will be noticed in the above statement that, with the exception of this item and that of postage, all other heads of expenditure are almost, if not quite, equal to the budget grants, notwithstanding that every endeavour has been made to keep the expenditure as small as possible. The expenditure on office rent has been rather larger than in previous years, but this is accounted for by the fact that in August last the office was removed into a larger house, and very much superior accommodation has been secured. The amounts under the two heads of expenditure in which savings are shown would not have been so large if it

were not that there had been delay in opening of one or two of the observatories, but with the full number of observatories which are now open, and with the extension of the rainfall registration which has been recently proposed, the margin for possible future savings in the budget grant of the department will be reduced to a very small figure.

The figures in the statement printed above give the total expenditure for the year as shown in the books of this office, but the statement does not include the cost of instruments supplied to the observatories by the Indian Meteorological Department, nor the cost of stationery supplied to the central office, nor the cost of printing the meteorological returns in the Gazette or otherwise, or of the forms required in the Meteorological Office, by the Bengal Secretariat Press.

A. PEDLER,

*Offg. Meteorological Reporter to the
Government of Bengal.*

METEOROLOGICAL OFFICE, BENGAL ;

The 15th June 1885.

APPENDIX B.

Extracts from the Administration Report of the Meteorological Reporter to the Government of the North-Western Provinces and Oudh for the year 1884-85.

During the first half of the year under report the Department remained in charge of Dr. Murray Thomson, who was relieved by the permanent incumbent of the provincial reportership on the 21st of October. There was no change in the number or status of the observatories, which therefore, on the 31st March 1885, stood as follows:—

How maintained.	CLASS.			
	I	II	III	
By Meteorological Department.	Allahabad (in abeyance).	Allahabad. Lucknow. Agra. Roorkee.	Chakráta. Ranikhet. Pithoragarh. Bareilly. Gorakhpur.	Benares. Sutna. Jhānsi. Sambhar. Ajmir.
By other Government Departments or public institutions.			Dehra. Meerut.	Gházípur. Nowgong.
Voluntarily or by Independent States.	Jaipur.			

The third class observatory at Dehra continues to be efficiently maintained by the Survey of India, though now deprived of the supervision of the distinguished meteorologist (Mr. J. B. N. Hennessey, F.R.S.) who long had charge of it, but is now retired from the service. The Meerut, Gházípur, and Nowgong observatories continue as heretofore to be supported by the Municipality, the Opium Factory, and the Rajkumar College of the three stations respectively.

FIRST CLASS OBSERVATORIES.

The fully-equipped observatory at Jaipur continued to do excellent work during the year. No new instruments were brought into use, but the meteorograph, Osler's anemometer and sunshine recorder furnished faithful automatic records, in addition to which the usual eye observations of the instruments indicating temperature, pressure, and rainfall were punctually made. The observatory was inspected by me at the end of December, and found in excellent order, the only alteration I had to suggest being the removal of the sunshine recorder to a more exposed position. This change has since been effected. An extract from Dr. Hendley's report on the working of this observatory during the year 1884 will be found below (Appendix BI).

The first class observatory at Allahabad is still in abeyance, and the old observatory continues to rank in the second class. The additional observations at 4 A.M. and 10 P.M., and those of sunshine, cloud movements and ground temperature, mentioned in previous reports, have been made throughout the year.

The new observatory building at the Chatham Lines, sanction for which was obtained at the beginning of 1885, has made good progress under the superintendence of Mr. J. Heinig, Executive Engineer of the Division, and will probably be completed by November next. The plot of land assigned to the observatory, only an acre, is rather small to accommodate the observatory buildings and out-offices, and give a free exposure to the thermometers in the shed which was erected on the ground in a somewhat awkward position before the foundations of the buildings were marked out; but as on three sides the site is bounded by a wide open plain over which the wind meets with no obstruction, the observations made will probably be fairly representative of the district. Temperature observations at the new site were commenced in September, and will be discussed below.

SECOND CLASS OBSERVATORIES.

The only one of these observatories, (besides that at Allahabad) inspected during the year, was Agra. At this station I found all the instruments clean and in excellent order, and there was every evidence that the observations were punctually and carefully made; but in the work of reducing the observations and in penmanship, the observer often exhibits signs of carelessness. Judging from the evidence of the registers, the Lucknow observer has worked carefully, punctually, and intelligently throughout the year, and the work of the Roorkee observer is now so much improved, that for the past year it has been nearly equal to that of the best observers in the province.

I am inclined to agree with what Dr. Thomson has said in last year's report about the disproportion between the amounts of work done by second and third class observers; but as the hourly observations, which constitute the heaviest part of the duties of observers at second class stations, have now been going on for nearly ten years, I think relief to the observers might be obtained by stopping them and reducing all the Government observatories, except Allahabad, to the third class.

THIRD CLASS OBSERVATORIES.

Only two of these—Sambhar and Sutna—were inspected during the year. At Sambhar, one thermometer was found out of order, and the pad for the nocturnal radiation instrument was wanting. The observer, who is a native doctor in charge of several dispensaries at the salt works round Sambhar Lake, is frequently unavoidably absent from the station, and then his place is taken by his son. Both father and son seem intelligent, and can read all the instruments correctly, but the divided responsibility is probably not conducive to that careful handling of instruments and accuracy of observation which merits reward.

At the Sutna observatory, from which the Superintendent is absent nearly half the year, everything was found in good order except the Casella anemograph, which was working very stiffly, and owing to some fault of construction, has never run freely since first put up.

The other third class observatories, to judge from the returns sent in, have continued in their usual state of efficiency.

* * * * *

SPECIAL OBSERVATIONS.

As mentioned above, special observations of the duration of sunshine, by a modification of Campbell's sunshine recorder, and of the movements of the upper clouds by means of a nephoscope, as well as of the temperature of the ground at various depths, were recorded at Allahabad and Jaipur.

* * * * *

The sunshine records for several days in July and August were lost owing to the removal of the instrument from the college to the tower mentioned in the report for last year. This tower has since been demolished in order that the materials might be incorporated in the new observatory building, and in the meantime the sunshine recorder has been replaced in its old position on the college roof, where the exposure is more complete than it was on the tower. In consequence of the removal to the tower, the percentage of bright sunshine during those months when the sky is most serene was apparently less than in former years.

The sunken thermometers continue to show that the mean temperature of the ground near the surface is about five degrees higher than that of the air. A more complete reduction of their readings will be attempted after the removal of the observatory to the new site, where, since the 1st January, observations of the ground temperature at the surface and at depths of 1, 3, and 9 feet have been made every day. The nephoscope observations have been tabulated up to the end of March, but have not yet been published.

Since the 1st September, observations of shade temperature and humidity have been made at the new observatory site, Allahabad. As far as they go, these indicate that there is little difference between the daily maxima or minima at the two places, but that at 10 A.M. and 4 P.M. the new site on a large open plain is considerably warmer than the old, which is surrounded by trees. The humidity at the new site is considerably less than at the old.

As regards both temperature and humidity, these observations are confirmed by those formerly made at the Muir College, when it was purposed to establish the permanent observatory there. The observations of the radiation thermometers show that in the cold weather nocturnal radiation is much more effective at the new than at the old site, as was to be expected from its more open character; though there is no such difference in the minimum temperature of the air, because the old observatory lies in a hollow where the cold air accumulates at night.

OFFICE AND OFFICE WORK.

As stated in the introductory paragraph, Dr. Murray Thomson held charge of the office up to the 21st October, when I returned from furlough. There was no change in the establishment of the office or of the Allahabad observatory, except the appointment from the 1st September of a temporary assistant to take observations at the new site. All the clerks and tabulators have worked well during the year, and the usual tabular statements and returns, as well as the permanent registers of the observations, have been punctually prepared.

The extra work completed during the year consisted of a paper on temperature and humidity observations at a height of 40 feet above the ground, at the new Calcutta Observatory, Alipore, prepared by me whilst acting as Meteorological Reporter to the Government of India, and a paper on the variations of solar radiation as computed from hourly observations of the black-bulb thermometer *in vacuo* at Lucknow. The former will be published in Vol. II of *Meteorological Memoirs* and the latter in the *Journal of the Asiatic Society of Bengal*. Some progress was also made with a comparison of the readings of the Fleming and Symons rain-gauges at numerous stations in the North-Western Provinces and Oudh. A short report on the subject has since been made to the Provincial Government. In this it is shown that whilst, at about half the stations, the readings of the old Fleming, or float-and-rod gauge, have been fairly accurate, at some of the others the error amounts to 20 per cent.; and that, on the whole, the proportion of erroneous gauges in the North-Western Provinces is less than in Oudh.

COST OF THE DEPARTMENT.

The last appendix gives the usual statement of the cost of the Department for the year. The total cost for the office and the observatories situated in the North-Western Provinces and Oudh was ₹12,563-14-11, or ₹493-13-1 less than the previous year. The decrease was partly in contingent expenses, but chiefly in travelling allowance. Nothing was charged under this head during the year, the only inspections of observatories having been made by me when acting as Meteorological Reporter to the Government of India.

S. A. HILL,

Meteorological Reporter to Govt., N.-W. P. and Oudh.

APPENDIX B I.

Extract from Report on Observatory at Jaipur by SURGEON-MAJOR HENDLEY.

The observers have all worked well during the year and have shown an intelligent interest in their duties. Babu Durga Parshad is especially to be commended for his care of the meteorograph.

The Superintendent has again to thank Mr. Callaghan, the electrician, for his excellent services during the year, to which he would beg to draw the favourable attention of his own department.

Automatic Instruments.—The Osler's anemograph has been working throughout the year. It was set up in its present position on January 4th, 1881.

Meteorograph.—All the parts of this instrument, except the anemometer, were in order on December 31st. The traces have been good, as a rule; but, owing to weakness of the etching fluid employed to deepen them, a number of the plates have been spoiled. Surgeon-Major Hendley, when on his way to England on leave in July 1883, visited Mons. Schubart, the maker of the meteorograph, who resides at Ghent, and ordered new anemometer springs capable of resisting the extreme changes of temperature at Jaipur, and pointed out several slight changes which experience had shown him might be made with advantage in this beautiful instrument when constructed for use in a tropical climate. He was glad to find his observation coincided with those made by other observers. Finding also that the Meidinger battery, recommended in Mons. Van Ryssberghe's manual, gave more satisfactory results at Brussels than that in use at Jaipur, he ordered a complete one to be sent to India; but although eighteen months have elapsed, his order as yet remains unfulfilled. Surgeon-Major Hendley, in the hope of being able to discover an easier method of converting the traces of the meteorograph into figures than by measuring and tabulating, has tried to obtain average curves for each month for the thermometer and barometer by drawing the curves for each day on tracing paper over the points obtained from the zinc plates or over the plates themselves, the ends of ordinates having been first joined by a fine red ink line which could be clearly seen through the tracing paper.

Mr. S. Hill has examined the traces, and is of opinion that, the scale being very small, the line, which has to be tolerably thick to be visible, is itself nearly equal to two degrees on the thermogram, and so gives rise to a great error. Moreover, there is so much liberty of choice, that a good reliable mean curve cannot be satisfactorily drawn.

The writer agrees in this view, and regrets that a method which was suggested to him by the success of Galton's photographic mode of obtaining mean curves, to which it seemed at first in some respects superior for his purpose and more easy of practice, should have failed. For open curves, in which the divergence is not great, the results would probably be better.

Mr. Whipple's plan of drawing the curves for two days and then tracing between them a mean, which can be compared with other curves produced in the same way, takes up so much time that it is questionable whether it would not be preferable to measure and tabulate at once. The latter method, he is afraid, will have to be adopted.

Sunshine Recorder.—The sunshine recorder in use here is fitted with Professor Stoke's zodiacal frame, which enables far more accurate results to be obtained than with the older frame of the instrument.

Early in 1885 the instrument was removed from the open compounds to a pillar on the top of the anemograph tower, so that it might be at all times exposed to the sun.

The ordinary instruments have been in good order throughout the year.

APPENDIX BII.

Names of the Superintendents and of the Observers at the Meteorological Observatories in North-Western Provinces and Oudh during the year 1884-85.

Observatory.	Class.	Officer in charge.	DATE.		Observers.	DATE.	
			From	To		From	To
Allahabad	Second	Dr. Murray Thomson	1st April 1884	21st October 1884	Kedar Nath Chatterji, observer	1st April 1884	31st March 1885.
Agra	Ditto	S. A. Hill, Esq.	22nd October 1884	31st March 1885	Sasibhusan Banerji, assistant observer	Ditto	Ditto.
		Dr. A. H. Hilson	1st April 1884	15th May 1884	Mir Altaf Ali, observer	Ditto	Ditto.
		" W. G. Robinson	16th May 1884	3rd August 1884	Abdul Majid Khan, assistant observer	Ditto	Ditto.
		" A. H. Hilson	4th August 1884	31st March 1885	Chotay Lal, observer	Ditto	Ditto.
Lucknow	Ditto	" J. Cameron	1st April 1884	15th November 1884	Durga Pershad, assistant observer	Ditto	Ditto.
		" J. C. Whishaw	16th November 1884	31st March 1885	Chiranjil Lal, observer	Ditto	Ditto.
Roorkee	Ditto	Captain G. Onslow, R.E.	1st April 1884	4th November 1884	Jugmohan Lal, assistant observer	Ditto	Ditto.
		Dr. Murray Thomson	5th November 1884	31st March 1885	Gunga Ram, assistant observer	1st June 1884	31st May 1884.
		Surgeon C. W. Owen, C.I.E.	1st April 1884	26th August 1884	Durga Pershad, observer	1st April 1884	31st March 1885.
Jeypur	First	Babu Jadoo Nath De	27th August 1884	13th September 1884	Nathu Narain, assistant observer	Ditto	Ditto.
		Surgeon-Major D. N. Martin	14th September 1884	25th October 1884	Harbux, assistant observer	Ditto	3rd August 1884.
Chakrata	Third	T. H. Hendley	26th October 1884	31st March 1885	Sher Pertap, assistant observer	4th August 1884	31st March 1885.
		Captain A. E. Ward	1st April 1884	Ditto	Salig Ram	1st April 1884	14th December 1884.
		Rev. J. L. Humphry, M.D.	Ditto	31st December 1884	Ram Kuttun	15th December 1884	14th January 1885.
Pithoragarh	Ditto	Dr. S. Dease	1st January 1885	31st March 1885	Salig Ram	15th January 1885	31st March 1885.
Ranikhet	Ditto	No Superintendent	1st April 1884	31st March 1885	Sher Singh	1st April 1884	Ditto.
Dehra	Ditto	Depy. Superintendent, Survey of India.	Ditto	Ditto	Jewa Nund	Ditto	Ditto.
Meerut	Ditto	Dr. W. Moir	Ditto	Ditto	The head computers	Ditto	Ditto.
Bareilly	Ditto	E. A. Phillips, Esq.	Ditto	Ditto	Harsaran Das	Ditto	Ditto.
Gorakhpur	Ditto	Dr. T. H. Sweeny	Ditto	17th November 1884	Jwala Pershad	Ditto	Ditto.
		" C. Prentis	18th November 1884	31st March 1885	Nizam-ud-din	Ditto	Ditto.
Benares	Ditto	G. Thibaut	1st April 1884	Ditto	Babu Devakinandan Pattak	Ditto	Ditto.
Chazipur	Ditto	" P. A. Weir	Ditto	Ditto	Har Nath	Ditto	Ditto.
Sutna	Ditto	" S. J. Goldsmith	Ditto	Ditto	Hira Lal	14th March 1885	13th March 1885.
		A. P. Mitchell, Esq.	Ditto	14th February 1885	Har Nath	18th March 1885	17th March 1885.
Nowgong	Ditto	John Mather, Esq.	15th February 1885	31st March 1885	Baldeo Parshad	1st April 1884	31st March 1885.
Jhansi	Ditto	Surgeon W. A. Simmonds	1st April 1884	30th November 1884	Kalka Das	Ditto	Ditto.
Sambhar	Ditto	Surgeon W. Moynan	1st December 1884	31st March 1885	Mr. J. Romare	Ditto	2nd May 1884.
		F. Ashton, Esq.	1st April 1884	Ditto	Habib-ul-la	3rd May 1884	31st March 1885.
Ajmere	Ditto	Dr. J. Croft	Ditto	21st November 1884	Ram Parshad	1st April 1884	Ditto.
		" J. H. Newman	22nd November 1884	31st March 1885			

APPENDIX BIII.

Statement showing the expenditure of the North-Western Provinces Meteorological Department for the year 1884-85 (not including stationery, printing, or cost of instruments).

STATION.	IMPERIAL SERVICES.			
	Establishment.	Contingencies.	Reporter's travelling allowance.	TOTAL.
	R a. p.	R a. p.		R a. p.
Meteorological Reporter	2,999 15 11	.....	.....	2,999 15 11
Ditto Office	3,182 0 0	1,084 10 9*	.....	4,266 10 9
Allahabad Observatory	720 0 0	.....	.....	720 0 0
Ditto New Observatory	105 0 0	.....	.....	105 0 0
Agra Observatory	900 0 0	22 8 3	.....	922 8 3
Roorkee ditto	900 0 0	13 0 0	.....	913 0 0
Lucknow ditto	1,005 0 0	24 0 0	.....	1,029 0 0
Chakrata ditto	240 0 0	30 0 0	.....	270 0 0
Ranikhet ditto	300 0 0	.....	.....	300 0 0
Pithoragarh ditto	180 0 0	.....	.....	180 0 0
Bareilly ditto	180 0 0	.....	.....	180 0 0
Gorakhpur ditto	180 0 0	41 12 0†	.....	221 12 0
Benares ditto	240 0 0	.....	.....	240 0 0
Jhansi ditto	216 0 0	.....	.....	216 0 0
TOTAL	11,347 15 11	1,215 15 0	.....	12,563 14 11

* Including office rent, charges for repairs to the observatories, and general contingencies of the Meteorological Office and Allahabad Observatory.

† Excluding charges for weather telegrams.

APPENDIX C.

Extracts from the Administration Report of the Meteorological Reporter to the Government of Punjab for the year 1884-85.

During the whole of the official year 1884-85 the Punjab Meteorological Department was under the control of my predecessor, Surgeon-Major E. Lawrie. My report is, therefore, compiled entirely from the office records at my disposal.

The more important incidents and particulars of the year under report are the following :—

1. In compliance with the expressed wishes of the medical authorities, and with the entire approval of the Meteorological Reporter to the Government of India, steps were taken towards the removal of the Lahore observatory from its unfavourable position in the compound of the Mayo Hospital to a far preferable one near the district jail. On the new site, one admirably adapted to the requirements of the Meteorological Department, is a suitable building set apart for meteorological purposes by the Government of the Punjab, and to it has been transferred the barometer which had been previously located in the Mayo Hospital. On an open space of ground at a short distance from the building, a thermometer shed has been erected, and has been fitted up with the usual instruments, and the spots where the rain-gauge and radiation thermometers are placed have been properly railed in. Observations have been taken at this new observatory since the 1st January 1885. In order, however, to ascertain the amount of change involved in the new arrangements and to secure the data necessary for a comparison between the results recorded at the old and those at the new sites (which are about 3 miles apart and very dissimilar in the character of the surroundings), the old thermometer shed near the Mayo Hospital has been retained as a *temporary observatory*, where observations are still taken as before. Such duplicate observations will, probably, be continued for a year or two and entail an additional monthly expenditure of Rs15-8.

2. During the year under report, a Beckley's anemograph was supplied to the Lahore observatory, but it has not been put up, as the tower required for its reception has not been erected. The Local Government, when addressed on the subject of the proposed tower, promised¹ to consider the matter in connection with the financial arrangements of the official year 1885-86.

3. The second class observatory at Ladakh, which was started primarily for actinometric observations, and which since its establishment in September 1871 had been under the Punjab Meteorological office, was transferred to the direct control of the Meteorological Reporter to the Government of India on 21st July 1884. The change referred to was considered desirable, because the actinometric observations taken at Ladakh were revised and calculated at Calcutta, and not in the Punjab office.

4. Besides those noted above no other important changes have been made in connection with the arrangements or management of the observatories under the Punjab Reporter, which were as follow at the close of 1884-85 :—

1. Lahore	.	.	.	.	.	2nd class observatory.
2. Delhi	.	.	.	.	.	3rd
3. Rawalpindi	.	.	.	.	.	"
4. Ludhiana	.	.	.	.	.	"
5. Murree	.	.	.	.	.	"
6. Sialkot	.	.	.	.	.	"
7. Simla	.	.	.	.	.	"
8. D. I. Khan	.	.	.	.	.	"
9. Mooltan	.	.	.	.	.	"
10. Sirsa	.	.	.	.	.	"
11. Peshawar	.	.	.	.	.	"

Of these it would appear that the observatories at Delhi, Rawalpindi, Ludhiana, Murree, Sialkot, Simla, and Sirsa were inspected by Dr. Lawrie during the year under report. This I gather from the

¹ Punjab Government's No. 3023, dated 2nd December 1884.

charges made on account of travelling allowances, but the results of the inspection are not known in the office. Dr. Lawrie has been requested to furnish particulars of the notes taken by him during his visits to the several stations. These when received will be submitted without delay, and may be treated as an appendix to this report. It would appear, however, that all the observatories worked satisfactorily, with the exception of that at Sialkot, in the reports of which numerous inaccuracies were detected, due probably to frequent changes in the observing staff.

5. The under-noted interruptions in the continuity of the meteorological observations in this province occurred during the year :—

Names of Observatory.	Dates on which observations were missed.	REMARKS.
Murree	24th May 1884.	The observer being on leave.
	29th July "	
	6th September "	
	6th October "	
	13th " "	
Rawalpindi	1st June 1884.	The observer being on leave.
	22nd August "	
	23rd " "	
	10th September "	
	12th " "	
	13th " "	
Mooltan	8th October "	Ditto.
	5th November "	
	18th May 1884.	
Simla	19th January 1885.	On account of the removal of the observatory.
	7th to 15th March 1885.	

* * * * *

6. Up to the 31st December 1884 the office of the Meteorological Reporter was held in the building near the Government College previously used as a dāk bungalow. But on the 1st January 1885 it was transferred to the building already alluded to, situated near the Lahore district jail. The office in its new quarters enjoys ample accommodation, and was in excellent order when I assumed charge of it on the 10th April last, reflecting great credit upon the Head clerk Lalla Jasput Rai, a most efficient, intelligent, and painstaking man, who is also the chief observer at Lahore.

7. The following statements are attached :—

C.I.—Table showing the names of the superintendents and observers at the meteorological observatories in the province of Punjab during the year 1884-85.

¹ *C.II.*—Return of instruments issued to each observatory in the province of Punjab in 1884-85.

J. CAMPBELL OMAN,
Meteorological Reporter for Punjab Government.

¹ Incorporated in Appendix K.

APPENDIX C I.

Table showing the names of the Superintendents and Observers at the Meteorological Observatories in the Province of Punjab during the year 1884-85.

No.	Observatory.	Class.	Names of Superintendents.	PERIOD.		Names of Observers.	PERIOD.		ALLOWANCES.	
				From	To		From	To	Monthly Allowance.	Meritorious Allowance.
1	Lahore	Second	Surgeon-Major E. Lawrie, Meteorological Reporter Punjab.	Through out		{ Jasput Rai, chief observer Divan Chand, assistant observer.	Through out		20	5
2	Delhi	Third	Surgeon-Major G. C. Ross Ditto J. R. Tzaffe Ditto G. C. Ross	1st April 1884	6th June 1884	{ Bansee Dhar	Through out		10	5
				7th June "	6th July "					
3	Rawalpindi	Ditto	Surgeon-Major G. Massy Ditto J. Bannett	1st April "	2nd April 1884	Asst.-Surgeon Bhugwan Dass	1st April 1884	31st Dec. 1884	15	
				3rd April "	31st Mar. 1885	Ditto Elai Bukhsh	1st Jan. 1885	17th Feb. 1885		
4	Ludhiana		Brigade-Surgeon R. Rouse Asst.-Surgeon Bhugwan Dass	1st April "	25th Oct. 1884	Ditto Kalinauth Rai	18th Feb. "	31st Mar. "		
5	Murree	Ditto	Rev. Geo. C. Peake	1st April "	26th Oct. "	Ditto Bhugwan Dass	1st April 1884	1st June 1884	15	
				23rd May "	21st Sept. "	Ditto Miran Bukhsh	2nd June "	9th Sept. "		
6	Sialkot	Ditto	Surgeon G. J. Shand Surgeon-Major E. Palmer Ditto J. C. Smith Ditto W. A. C. Roe	1st April 1884	22nd May 1884	Ditto Bhugwan Dass	10th Sept. "	30th Nov. "	15	
				22nd Sept. "	30th Sept. "	Ditto Brij Lal	1st Dec. "	31st Mar. 1885		
7	Simla	Ditto	Asst.-Surgeon Jowar Singh Surgeon-Major E. Palmer Asst.-Surgeon Sunder Mull Capt. A. B. Fenton, Quarter-Master	1st April 1884	21st Sept. "	Mr. Cruickshank	Through out		15	5
				23rd May "	21st Sept. "					
8	Dehra Ismail Khan	Ditto	Surgeon A. P. Holmes Ditto A. W. Mackenzie Ditto C. Macartie Ditto A. W. Mackenzie Ditto A. P. Holmes	1st April 1884	30th April 1884	Asst.-Surgeon Sada Nand	1st April 1884	4th Dec. 1884	15	
				1st May "	5th Aug. "	Ditto Jowar Singh	5th Dec. "	28th Feb. 1885		
9	Mooltan	Ditto	Pundit Jaswant Rai Surgeon T. E. L. Bate	1st April 1884	30th April 1884	Sunder Mull.	1st Mar. 1885	31st Mar. "		
				1st May "	20th Aug. "		Through out		15	5
10	Sirsa	Ditto	Apothecary R. Crossby	1st April 1884	1st Oct. 1884	Sergeant J. J. Koings	Through out		15	
				1st May "	31st Mar. "					
11	Peshawar	Ditto	Surgeon T. E. L. Bate Surgeon-Major J. M. Fleming Surgeon T. E. L. Bate Ditto W. Coates, M. D.	1st April 1884	1st Oct. 1884	Noor Bukhsh	Through out		15	
				1st May "	31st July "	Wahid Ally	Through out		15	5
				1st Aug. "	15th Sept. "	Fazal Rahman	1st April 1884	31st Oct. 1884		
				16th Sept. "	7th Jan. 1885	Shirdyal	1st Nov. "	31st Mar. 1885		
				8th Jan. 1885	31st Mar. "	Kashi Ram	Through out		15	5

J. CAMPBELL OMAN,
Meteorological Reporter to Government, Punjab.

APPENDIX D.

Administration Report of the Sanitary Commissioner, Central Provinces, for the year 1884-85.

I have the honour to submit the report on the working of the observatories in the Central Provinces for the year 1884-85.

2. The observatories remained the same as last year.

3. I have inspected all the observatories, except those at Seoni, Sambalpur, and Sironcha, since the submission of my last report.

4. *Nagpur*.—Inspected September 30th, 1884. All the instruments were found in good order, and the shed in good repair.

The observer was transferred to the office of the Deputy Surgeon-General on 22nd May, and the assistant observer promoted. The hospital assistant attached to the Central Jail (close to which the observatory is placed) being appointed assistant observer.

The present observer reads correctly, and is well reported of.

5. *Fubbulpore*.—Inspected October 22nd, 1884. The shed, which is not on the standard plan but with venetians all round, was in good repair, and the instruments in good order, except the following :—

- (1) The anemograph, which was placed on the top of the Central Jail tower, had not worked for a long time, and was useless as it was ; it has since been removed with the view of its being put in order, and set up : if placed on the jail tower, that structure will have to be altered to convert it round into a flat top.
- (2) The minimum wet bulb thermometer read 4° lower than the hygrometer wet bulb. Mr. Hill inspected this observatory and gave a new scale of readings for this thermometer.

The observer reads correctly, and is well reported of, except that he is occasionally unpunctual.

6. *Pachmarhi*.—Inspected October 18th, 1884. The thermometer shed had been lately blown down ; a new one was under construction, and was finished on 1st December. The thermometers were, while the shed was being built, placed in the room with the anemograph, a brick building usually kept closed.

The observer was found extremely careless in the way he read the barometer, his carelessness necessitating the rejection of the registers kept by him ; he was fined by your orders.

7. *Chanda*.—Inspected October 9th, 1884. The shed and instruments were in good order, except that the wind-vane was surrounded by trees higher than itself ; it has since been removed to an open space, a new pillar having been built for it.

Shed in good order. The observer is well reported of.

8. *Saugor*.—Inspected January 30th, 1885. The shed is not of the standard pattern, but surrounded with venetians. The palings require renewal.

The grass radiation thermometer in place of being placed on a pad, as directed, was exposed on a bare board.

The solar radiation thermometer had a small piece of the mercury detached and fixed at the upper end of the tube.

The observer was well reported of, and read correctly ; he exchanged places with the man at Hoshangabad in February. Two rain-measure glasses were broken.

9. *Seoni*.—The thatch of the shed was renewed. The observer is well reported of.

10. *Hoshangabad*.—Inspected January 9th, 1885. The palings of the shed were in bad repair.

The solar radiation thermometer had a small piece of the mercury detached and fixed at the top of the tube.

The observer was well reported of as regards his observatory work, but his conduct was not quite satisfactory ; he exchanged stations with the observer at Saugor.

One solar radiation thermometer was broken.

11. *Khandwa*.—Inspected December 8th, 1884. The shed and instruments were found in very good order.

The observer is well reported of.

12. *Raipur*.—Inspected November 18th, 1884. The shed is old; a new one will be constructed this year. The instruments were all in good order, but the wind-vane is placed rather low.

13. *Sambalpur*.—The observer, who had hitherto been favourably reported of and was in the receipt of an extra allowance, was detected in recording readings which were impossible.

The thermometer readings of the instruments in the old observatory also appeared to have been entered all wrongly, so that the registers had to be rejected.

One solar radiation thermometer was broken.

14. *Sironcha*.—New posts and ladder to the anemometer were supplied during the year. The readings of the barometer were found untrustworthy, and the registers had to be rejected.

The Superintendent of the Chanda observatory was requested, at his visit to Sironcha, to carefully inspect the instruments, and test the fitness of the observer for his post. The Superintendent's report was that the instruments were in good order, but the eye of the observer not quite on the proper level when reading the barometer, and that he could read correctly.

15. The usual statements of instruments issued from this office, and of the names of superintendents and observers, are appended.

16. To obviate the difficulty hitherto experienced in getting a man fitted to take the place of an observer going on leave, or falling ill, an additional assistant observer on Rs 10 per mensem was sanctioned by the Government of India in September 1884.

17. A suitable man has been entertained and trained at the Nagpur observatory, to which he will be attached when not elsewhere required.

JAMES H. LOCH, M.D.,
Deputy Surgeon-General and
Sanitary Commr., Central Provinces.

APPENDIX DI.

Names of Superintendents and Observers at the Meteorological Observatories in the Central Provinces during the year 1884-85.

Observatory.	Class.	Officer in Charge.	DATE.		Observer.	DATE.		REMARKS.
			From	To		From	To	
Nagpur	Second	{ Surgeon-Major R. T. Wright, M.D. Surgeon-Major J. F. Barter Surgeon-Major R. T. Wright, M.D. .	1st April 1884	23rd April 1884	{ T. V. Allagheri Swamy . . . P. Soobiah Hospital Assistant Abid Hussain, assistant observer Hospital Assistant Mohamed Abdul Rahimon Hospital Assistant Abid Hussain . . Sudhram Dubey, observer Hospital Assistant Mohun Lal, assist- ant observer Hospital Assistant Koonji Behari Lal, assistant observer Hospital Assistant Ram Lagan Sing, assistant observer Pandit Kesho Rao, observer . . . Lachmon Rao, assistant observer M. Venketachellum, assistant ob- server Deen Dyal Narain Rao Jadunath Bose Jadunath Bose Hospital Assistant Govind Vittal . Narain Rao Behari Lal Purasari Punchan Seetaram Hospital Assistant P. Muthu Krishna Naidu Kishen Rao Sham Soonder Das Hospital Assistant Syed Mohamed Hyder Hussein Hydari Additional Observers for special duplicate readings. Syed Mohamed Hyder Hussein Hy- dari Shuresh Chunder Ghose	23rd April 1884	22nd May 1884.	
			24th April	11th July 1885		23rd May	31st Mar. 1885.	
			12th July	31st March 1885		1st April	22nd May 1884.	
Jubbulpore	Ditto	{ Brigade-Surgeon W. R. Rice, M.D. Surgeon-Major R. T. Wright, M.D. Brigade-Surgeon W. R. Rice, M.D. .	1st April	1st May 1884		10th Nov.	9th Nov.	
			2nd May	3rd July		20th Mar. 1885	19th Mar. 1885.	
			4th July	31st Mar. 1885		1st April 1884	31st Mar.	
Pachmarhi	Ditto	{ R. Obbard, Esq., Asst. Commr. Surgeon-Major Turton, A.M.D. Surgeon-Major Drury, A.M.D. .	28th April	30th June 1884		17th April	16th April 1884.	
			1st July	25th Aug.		7th July	6th July	
			26th Aug.	31st Mar. 1885		1st April	31st Mar. 1885.	
Saugor	Third	{ Surgeon-Major E. O. Tandy Surgeon-Major Boalch Surgeon-Major Browne Surgeon Armstrong Surgeon Warlike Surgeon Henderson Surgeon-Major Cullen, M.D. . . . Surgeon-Major Gaffney Assistant Surgeon Shib Chunder Bhattachary Narhar Govind, Tehsildar Runga Rao Narhar Govind Brigade-Surgeon Trinnell	1st April	27th Nov. 1884		1st Jan. 1885	31st Mar. 1885.	
			28th Nov.	31st Mar. 1885		1st April 1884	31st Mar. 1885.	
			1st April	22nd April 1884		20th May	31st Dec. 1884.	
Hoshangabad	Ditto	{ Surgeon-Major Browne Surgeon Warlike Surgeon Henderson Surgeon-Major Cullen, M.D. . . . Surgeon-Major Gaffney Assistant Surgeon Shib Chunder Bhattachary Narhar Govind, Tehsildar Runga Rao Narhar Govind Brigade-Surgeon Trinnell	23rd April	23rd July		1st April 1884	10th Feb.	
			24th July	22nd Dec.		20th Feb. 1885	28th Feb.	
			23rd Dec.	31st Mar. 1885		1st Mar.	31st Mar.	
Khandwa	Ditto	{ Surgeon-Major Gaffney Assistant Surgeon Shib Chunder Bhattachary Narhar Govind, Tehsildar Runga Rao Narhar Govind Brigade-Surgeon Trinnell	1st April	31st Mar.		1st April 1884	31st Mar.	
			1st April	31st Mar.		1st April	31st Mar.	
			1st April	31st Mar.		1st April	31st Mar.	
Sironcha	Ditto	{ Surgeon-Major Gaffney Assistant Surgeon Shib Chunder Bhattachary Narhar Govind, Tehsildar Runga Rao Narhar Govind Brigade-Surgeon Trinnell	1st April	31st Mar.		1st April	31st Mar.	
			1st April	31st Mar.		1st April	31st Mar.	
			1st April	31st Mar.		1st April	31st Mar.	
Raipur	Ditto	{ Surgeon-Major Gaffney Assistant Surgeon Shib Chunder Bhattachary Narhar Govind, Tehsildar Runga Rao Narhar Govind Brigade-Surgeon Trinnell	1st April 1884	31st Mar.		15th Mar. 1885	31st Mar.	
			1st April	31st Mar.		1st April	31st Mar.	
			1st April	31st Mar.		1st April	31st Mar.	
Sambalpur	Ditto	{ Honorary Surgeon-Major Harrison Surgeon Collington Honorary Surgeon-Major Harrison Surgeon Collington Honorary Surgeon-Major Harrison Surgeon Poynder	1st April	14th April 1884		1st April	13th April 1884.	
			15th April	21st May		1st April	15th Oct.	
			22nd May	31st Nov.		1st April	15th Oct.	

¹ From 1st to 27th April 1884 no superintendent.

APPENDIX E.

List showing the names of the Superintendents and Observers at the Meteorological observatories reporting immediately to the Office of the Meteorological Reporter to the Government of India during the year 1884-85.

Observatory.	Class.	Names of Superintendents.	PERIOD.		Names of Observers.	PERIOD.	
			From	To		From	To
Aden	Second	Major F. M. Hunter, Bo. S. C.	1st April 1884.	31st March 1885	{ Walter Abraham, observer . . . B. C. Cordiers, assistant observer .	1st April 1884.	31st March 1885.
Bushire	Third	Lieutenant-Colonel E. C. Ross, C.S.I.	1st April "	31st March "	{ Mr. D. A. F. Azivedo . . . Mr. A. Paes . . .	1st April "	16th Nov. 1884.
Quetta	Ditto	{ Surgeon J. C. Fullerton, M.B. Ditto R. T. Baker, M.B. Ditto J. C. Fullerton, M.B.	1st April " 16th April " 17th July "	15th April 1884 16th July " 31st March 1885	{ A. Samuel Pillay . . .	1st April "	31st March "
Leh	Second	B. Rowland, Sergeant, R.E.	1st April "	31st March "	{ Suss Kagah, observer . . . Hashmat Ali, assistant observer .	1st April "	31st March "
Chamba	Third	J. Hutcheson . . .	16th Sept. "	16th Dec. 1884.	Barkhurdar Khan . . .	1st April "	31st March "
Kailang	Ditto	Rev. A. W. Heyde . . .	1st Sept. "	31st March 1885	T. Dana . . .	16th Sept. "	31st March "
Pachpadra	Ditto	{ G. A. Bradford . . . G. Scully . . . G. A. Bradford . . .	1st April " 11th April " 10th July "	10th April 1884. 9th July " 31st March 1885	{ Rashbehari Ghosh . . . Moorat Lall . . . Gopal Chundra Banerji . . . Moorat Lall . . .	1st April " 20th July " 7th Oct. " 30th Oct. "	5th June 1884. 6th Oct. " 20th Oct. " 31st March 1885.
Mussooree	Ditto	Rev. Fr. Benedict . . .	1st April "	31st March "	.....	.....	.....
Katmandu	Ditto	.....	.....	.....	{ Mohamad Hussain . . . Pashupat Sharan Sinha . . . Mohamad Hussain . . .	1st April 1884. 14th Jan. 1885. 14th March "	13th Jan. 1885. 13th March " 31st March "
Pedong	Ditto	Rev. A. Desgodins, S.J.	1st Feb. 1885.	31st March 1885	Rev. A. Desgodins, S.J.	1st Feb. "	31st March "
Mongpoo	Ditto	.....	.....	.....	George A. Gammie . . .	1st April 1884.	31st March "
Makhlā	Ditto	J. Balantine . . .	1st April 1884	31st March 1885	Papannah . . .	1st April "	31st March "
Diamond Island	Ditto	.....	.....	.....	F. W. Marsh . . .	1st April "	31st March "
Port Blair	Ditto	Surgeon-Major J. Reid, M.B.	1st April 1844	24th April 1884.	{ J. T. Peters . . .	1st April "	31st July 1884. ¹
Nancowry	Ditto	Ditto W. N. Keefer . . .	25th April "	31st March 1885	{ Roop Sing Rana . . . Shaik Kabeeruddeen . . . S. Thomas . . .	1st April " 8th July " 22nd Jan. 1885.	31st March 1885. 7th July 1884. 21st Jan. 1885. 31st March "

¹ The observatory was in abeyance since this date.

APPENDIX F.

Extracts from the Administration Report of the Meteorological Reporter for Western India for the year 1884-85.

The work of the Meteorological Department of Western India has been carried on nearly in the same manner as in the previous year. Mr. A. N. Pearson, A.I.C., F.C.S., F.R. MET. S., continued to act as Meteorological Reporter for Western India up to the 10th November 1884, when I reverted to the office. No new observatories have been established, but the one at Zanzibar has unfortunately been closed, just at the time when there seemed a good prospect of the observations being turned to useful account for the purpose of forecasting the general character of the rainy seasons in India. It was hoped that the observations might have been continued under some arrangement with the authorities of the English Foreign Office, to whom the administration of British affairs at Zanzibar had been transferred from the Government of India, and, as a temporary measure, the observer from India was allowed to remain at the station. He was recalled, however, at the end of September 1884, and the observations were afterwards recorded, whenever possible, by Dr. Williams, the Agency Surgeon; but on the untimely death of that officer in December 1884, the registrations ceased and have not since been resumed. Mr. E. E. Sawyer, Chief Engineer and Agent of the Western India Portuguese Guaranteed Railway, has established an observatory at Mormugao in connection with the harbour works there. The observatory is furnished with a large Robinson-Beckley anemograph and a large standard observatory barometer by Casella, as well as with various thermometers. Since the 1st October 1884, Mr. Sawyer has very kindly telegraphed the 10 A.M. readings of the various instruments to the Bombay office, and still continues to do so. The observations are thus made available for the purposes of the storm-warning service, and in return for the assistance thus rendered, any information at the disposal of the office as to atmospheric disturbances which may possibly cause rough weather at Mormugao is communicated to Mr. Sawyer by telegraph.

The observatories sending registers to the Bombay Meteorological Office during the year may be classified as follows:—

Province.	Second class.	Third class.
Bombay Presidency	Karachi Deesa Poona Belgaum	Jacobabad.
		Hyderabad.
		Bhuj.
		Rajkot.
		Surat.
Rajputana	Malegaon.
		Sholapur.
		Ratnagiri.
		Karwar.
		Mount Abu.
Central India	Bickaneer.
		Neemuch.
		Indore.
Berar	Amraoti.
		Akola.
		Chikalda.
Malabar Coast	Buldana.
		Calicut.
Africa	Zanzibar.

There are in all four observatories of the second class and nineteen of the third class. At each of them two sets of observations are recorded daily, and at the second class stations hourly observations are also recorded on four days in each month. There are also more than four hundred stations at which the daily rainfall is regularly recorded, but these are not under the supervision of the Meteorological Department. Copies of the registers of the daily rainfall at these stations are furnished annually to this office, where they are preserved for future reference.

Appendix F I contains a list of the observatories, and shows the names of the superintendents and of the observers who have held office during the year.

Meteorological Buildings.—A new fence has been made at Hyderabad for the radiation thermometers and rain-gauge. The thatch of the thermometer shed at Karwar has been renewed. New outer shutters have been fitted to the small windows of the anemometer tower at Deesa, and a new iron ladder has been made to provide easy access to the anemometer. The trap door in the roof of the tower has also been altered to secure greater convenience and safety. These are the only changes of any importance that have been reported to the Bombay Office.

Instruments and their verification.—The following table¹ shows what instruments have been issued during the year. They were all verified by comparison with the standard instruments before being despatched to their destinations.

There is not a single instance of a breakage in the first six columns of the table. This speaks well for the general carefulness of the observers, and also proves that the breakages shown in the next two columns are mainly due to the conditions of exposure.

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The large Robinson-Beckley anemographs at Deesa and Belgaum have given nearly continuous traces throughout the year; that at Deesa was out of action for seven days in all, and the one at Belgaum for five days. The Belgaum traces are somewhat imperfect, from the 18th December 1884 to the 8th January 1885, on account of some instrumental derangement, but I think it will be possible to tabulate the data satisfactorily. The Casella anemograph at Poona has been out of action on six days, and that at Ratnagiri on one day, when the instrument was dismounted and cleaned. The traces of these two instruments are, however, faulty on all days when the wind was calm.

In my report for the year 1880-81, I pointed out how very variable the direction of the wind is at Deesa, in the day hours during the dry weather. The traces of the Belgaum anemograph show that the same phenomenon obtains at that station also, and there is little doubt that it obtains generally at all inland stations. This fact throws great light on the nature of the "hot winds," and shows them to be mainly due to the small atmospheric whirl-winds which are the direct effect of solar radiation, not to corresponding variations of the barometric gradients between widely separated stations. The standing difficulty in the theory of these winds, *viz.*, that they are not accompanied by such barometric gradients as are always observed in the case of convection currents, is thus removed, and it also becomes clear why that component of the diurnal variation of the wind velocity, which is due to these winds, should vary in the same manner as the solar radiation, a fact which I long ago pointed out in my paper on the winds of Karachi. Any theory of the "hot winds," which does not carefully distinguish between that part of the motion which is due to the atmospheric whirls, and the small residual part which may be a true convection current, must therefore be unsound.

Training of Observers.—The observers whose names are given below finished a course of training in the Bombay Office on the dates specified. Most of them were appointed to observerships at the stations placed opposite to their names. The two last were trained at their own request in the hope of being able to fill future vacancies.

Minguel Fernandez	.	.	.	.	1884 April	5th	.	.	.	Karachi.
S. K. Gadgil	.	.	.	.	" July	10th	.	.	.	Mount Abu.
Bulwant Luxman	.	.	.	.	" "	12th	.	.	.	Sholapur.
G. C. Moodliar	.	.	.	.	" October	28th	.	.	.	Rajkot.
Chhaganlal Harilal	.	.	.	.	" November	12th	.	.	.	Surat.
Shaik Mahomed.	.	.	.	.	" "	"	.	.	.	Malegaon.
Shunkerji Naronji	.	.	.	.	1885 March	25th	.	.	.	Bhuj.
Devji Mulloo	.	.	.	.	1884 July	16th.	.	.	.	
Bhan Vithoji	.	.	.	.	" August	21st.	.	.	.	

¹Incorporated in Appendix K.

Most of these young men were trained to fill the observerships formerly held by Military Hospital Assistants, the services of the latter as meteorological observers having been dispensed with chiefly because of the interruptions of the meteorological work caused by their frequent transfer from one station to another on military duty. It has yet to be seen whether the alternative plan of appointing, on a low rate of pay, youths who have no other duty to perform will work well. One of them has already left his post without permission.

Character of the work of the Observers.—As in previous years, the observations recorded by trained and experienced observers are accurate and trustworthy; but in those instances where untrained and inexperienced men have been employed, there are, as a rule and for a time, imperfections in the observations. The observations recorded at Jacobabad, Bickaneer, Karachi, Deesa, Indore, Rajkot, Surat, Akola, Chikalda, Poona, Sholapur, Ratnagiri, Belgaum, Karwar, and Zanzibar appear to be thoroughly trustworthy throughout the year, but some of those recorded at Hyderabad, Bhuj, Mount Abu, Neemuch, Amraoti, Buldana, and Malegaon have, for a short time, been unreliable, either from erroneous observation or faulty manipulation of the instruments. However, even at these latter stations, by far the greater portion of the work has been satisfactorily performed.

The following statement shows all cases of total interruption of the records for more than a day or two, but it does not include partial interruptions arising from derangements or breakages of instruments. With the exception of these interruptions, and one presently to be mentioned, the observations may be regarded as practically continuous at all the twenty-three stations.

List of Interruptions of the Observations.

STATION.	Date.	Cause of Interruption.
Jacobabad	From 1884 November 30th to 1884 December 4th .	Observer sick.
Bhuj	" " September 10th " " September 15th .	" "
"	" " October 1st " " October 15th .	No observer.
Mount Abu	" " June 9th " " June 30th .	" "
Sholapur	" " April 1st " " May 4th .	" "
"	" 1885 February 8th " 1885 February 17th .	Observer sick.
Karwar	" 1884 April 19th " 1884 April 22nd .	" "
Zanzibar	" " September 3rd " " September 15th .	Observatory closed temporarily.

The observations recorded at Zanzibar are fragmentary from 1884 October 1st to December 24th, and the observatory was closed on the date last named, in consequence of the illness and subsequent death of Dr. Williams.

Storm Warning Service.—This service has been carried on as in previous years. Daily telegrams are received from eight stations on the west coast of India, and from three on the Coromandel coast. They do not furnish sufficient data to make it possible to draw satisfactory weather charts, and hence anything like a complete view of the meteorological conditions of the area which is supposed to be protected cannot be obtained from the daily reports. To remedy this deficiency in some measure, the office is empowered to call for special reports from additional stations whenever the regular daily reports show that a disturbance is in existence; but the time lost in calling for, preparing, and sending in these reports causes the information to be of but little value.

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Cautionary telegrams were sent to various ports as shown in the following table, but no orders to hoist the storm signals were issued during the year:—

Names of Ports.	Dates of cautionary telegrams.
Karachi	22nd June, and 8th and 9th September.
Bhavnagar	22nd June, and 8th September.
Daman	22nd June, and 8th September.
Bombay	21st November.
Ratnagiri	21st "
Vingorla	21st "
Karwar	21st "
Kumta	21st "

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Inspection of Observatories.—Twelve of the observatories have been inspected during the year, namely, those at Surat, Deesa, Mount Abu, Neemuch, Indore, and Malegaon by Mr. Pearson, and those at Poona, Sholapur, Ratnagiri, Belgaum, Karwar, and Karachi by myself. I also visited the observatory at Goa, which is maintained by the Portuguese Government, and the one at Mormugao which has been established by Mr. Sawyer. The condition in which Mr. Pearson found the observatories inspected by him was described in his report for last year. The results of my own inspections are given below.

Poona.—Most of the instruments were in good order, and all appeared externally to be clean and well kept. The inner surface of the glass jacket of the sun thermometer seemed slightly dimmed, and one side of the inner surface of the barometer cistern was dirty, but as the other side was clean and the zero point could be accurately adjusted, I did not disturb the instrument. I compared the barometer and thermometers with the portable standard instruments, and obtained the results shown in the following table of errors. On testing the orientation of the wind vane, I found it to be one point out of position, the index pointing to south by east when the vane was pointed to south. This change appears to have been due to the gradual lengthening of the chains, which connect the vane to the recording apparatus. To remedy the defect, I lowered the slab on which the lower portion of the instrument rests, and re-adjusted the index and embossing arrows to correspond with the position of the vane. The hole in the slab, through which the clock pendulum passes, was at the same time enlarged, to prevent contact of the pendulum with the slab. On the whole, the instrument has worked as well as can be expected, considering the faulty principle on which it is constructed.

Sholapur.—The observer at this station appears to be a painstaking man, but his education is defective, and I doubt his capability of understanding the instruction book. The instruments were all clean and in a serviceable condition, but there were several small defects which a more intelligent man would have rectified. The iron pipe which supports the anemometer had worked somewhat loose, and the flag for observing the wind direction was made of a small piece of stiff strong cloth, instead of a long piece of thin soft cloth which would be easily moved by light winds. The instruments in the thermometer cage were all clean and in good order, but a broken bottle containing a reserve supply of water for the wet bulb thermometers was found inside the cage. The results of my comparisons of the instruments with the portable standards are given in the following table.

Ratnagiri.—The observer at this station, Mahadev Cuddum, is one of the best in Western India. Everything was in good order. The anemograph was dismounted and cleaned during my visit. A few links of one of the chains were removed, and the instrument was re-adjusted. The instruments were all compared, as usual, with the standards, and the results are given in the table of errors.

Belgaum.—I inspected this observatory in January 1885, and found most of the instruments in good order, but the woollen material which forms the pad for the nocturnal radiation thermometer had almost all disappeared, and had not been renewed. The large Robinson-Beckley anemograph was, to all outward appearance, in good order, but the traces showed many instances of peculiar change of wind direction, which led me to suspect that the movements of the vane were being opposed by a considerable amount of friction. Accordingly, with the aid of a highly intelligent mechanic who was found on the spot, I completely dismounted the instruments, and it was then found that both sets of friction wheels were so much clogged with rust and dirt that they would not turn. Every part was thoroughly cleaned, clock and recording apparatus included, and afterwards remounted and re-adjusted. An improvement was also made by removing several slack pins from the connecting tubes, and substituting screw clamps for them.

Karwar.—At this observatory all the instruments were in good order, and everything was clean and tidy. On taking comparative readings of the barometer and the portable standard, I noticed, however, that the zero adjusting screw did not work well, and on opening the cistern I found the plunger had worked loose from its embedded female screw. It was temporarily fixed with sealing wax.

Karachi.—The only defects at this observatory were that the small inverted cup at the top of the shaft of the anemometer had worked loose, and that the observatory clock had stopped, the observer keeping time by his own watch. The loose cup had been fastened temporarily, however, by inserting a layer of thin muslin, and it has since been properly re-soldered. In all other respects

the observatory was in very good order. The observer at this station has occasionally been some days late in sending in his registers, but latterly I have had no cause to complain of such negligence.

Alterations of the errors of the Instruments.—The following table shows the alterations that have taken place in the errors of the various instruments between the time when the errors were first determined and the time of the last inspection, the sign + meaning that the index error has risen the sign — that it has fallen :—

STATIONS.	Barometer.	THERMOMETERS.					
		Dry bulb.	Wet bulb.	Dry maximum.	Dry minimum.	Wet minimum.	Grass minimum.
	Inch.	°	°	°	°	°	°
Poona	—'005	+0'1	+0'1	+0'2	0'0	—0'4	—0'5
Sholapur	+ '006	+0'2	+0'2	+0'2	+0'1	—0'7	—0'1
Ratnagiri	—'004	+0'3	+0'5	+0'1	0'0	—0'5	0'0
Belgaum	—'006	+0'1	0'0	+0'3	—0'2	—0'4	+0'4
Karwar	—'006	+0'5	—0'2	+0'4	—0'4	—0'4	—0'6
Goa	+ '001	+0'1	+0'3	+0'1	+0'1	+0'7	+0'7
Karachi	—'005	+0'2	0'0	+0'1	—0'1	—0'2	+0'1

Office Establishment.—At the end of the year the office establishment stood as follows :—

Name.	Monthly pay.
FOR LAND METEOROLOGY.	
Ganesh Sadashiv	R 60
Vajeram Iccharam	45
Mahadev Ramchandra	40
Krishnaji Ram Chandra	30
Ramchandra Sadashiv	30
FOR STORM WARNING SERVICE.	
Govind Sitaram	30
Anant Vishvamber	30

There are also two servants each on ₹10 per mensem.

The number of clerks for land meteorology is the same as it was in 1877. * * * * *

Library.—One-hundred and twenty-seven books and pamphlets have been presented to the library during the year. They have all been entered in the catalogue, which now contains 951 works on meteorology and allied subjects.

Work of the Bombay Office.—As in previous year, the work of the office has consisted almost exclusively of the correction and reduction of the observations from the nineteen third class observatories; the careful examination of the corrected and reduced observations of the four second class observatories; the curving and checking of the observations of all the observatories; the training of observers; the determination of the errors of all the instruments issued; and the carrying on of the correspondence, &c. The monthly tabular returns, showing the daily, half-monthly, and monthly results, as well as all the individual observations, have been regularly and punctually forwarded to the office of the Meteorological Reporter to the Government of India about six weeks after the close

of the month in which the observations were made, and monthly abstracts of results have been published in the *Bombay Government Gazette*. Copies of the registers of daily rainfall in the year 1883 from 408 stations have been collected, and those not already written out in English have been translated from the vernaculars in which the originals were kept. Copies of the registers of the daily rainfall at a number of stations during many past years have been made for the Meteorological Reporter to the Government of India by clerks temporarily engaged for the purpose. Some special calculations, which had for their object the elucidation of discrepancies in the abnormal variations of barometric pressure at certain stations, have also been made.

Special Work.—A brief sketch of the meteorology of the Bombay Presidency for the year 1883-84 was prepared by Mr. Pearson for incorporation in the Administration Report of the Government of Bombay. Mr. Pearson's paper entitled "Some results of an examination of the barometric variations in Western India" has been published *in extenso* in the Quarterly Journal of the Royal Meteorological Society for October 1884, and an abstract of his description of a new component anemograph, invented by himself, appeared in the number for January 1885. Mr. Pearson has also written a note on the rainfall of Northern India, which was published in the Journal of the Asiatic Society of Bengal. A note by myself on Mr. Blanford's theory of the winter rainfall of Northern India has also appeared in the November number of the journal. This note excited some adverse criticism from Messrs. Blanford and Eliot, to which I was invited to reply. I did so early in December last, but have not as yet seen the reply in print.

In conclusion, I thankfully acknowledge the services gratuitously rendered by the superintendents of the observatories. They have cordially given me all the assistance in their power.

APPENDIX FI.

Names of the Superintendents and of the Observers who have officiated at the Observatories in Western India during the year 1884-85.

STATION.	Class.	Superintendent.	PERIOD.		Observer.	PERIOD.		REMARKS.
			From	To		From	To	
Karachi . . .	Second	Surgeon D. O'Sullivan Brigade-Surgeon C. H. Gerand .	1884 1st April 12th April	1884 11th April 31st Mar.	Narayan Vinayek Minguel Fernandez . Hassan Kadar (assistant) .	1884 1st April 10th April 1st April	1884 9th April 31st Mar. 1885. 31st Mar.	
Deesa . . .	Ditto	Surgeon-Major F. Lyons Surgeon P. J. Damania .	1884 1st April 14th Aug.	1884 13th Aug. 28th Sep.	Ramkrishna Keshav . Dayal Bhala (assistant)	1884 1st April 1st April	1884 31st Mar. 31st Mar.	
		Surgeon-Major F. Lyons . No Superintendent . Surgeon-Major W. P. Bridges . Ditto A. Barry . No Superintendent . Surgeon-Major W. P. Bridges .	1884 29th Sep. 6th Nov. 1st Dec. 2nd Jan. 15th Jan. 13th Mar.	1884 5th Nov. 30th Nov. 14th Jan. 12th Mar. 31st Mar.				
Yerrowda (Poona) .	Ditto	Ditto S. M. Salaman .	1884 1st April	1884 31st Mar.	Narayan Sakham . G. C. Moodliar (assistant) C. S. Moodliar (ditto)	1884 1st April 1st April 20th Oct.	1884 31st Mar. 19th Oct. 31st Mar.	
Belgaum . . .	Ditto	Ditto R. P. Ferguson Ditto R. Harmon .	1884 1st April 1st Mar.	1884 28th Feb. 22nd Mar.	Ramchandra Datta . Keshav Hari (assistant) Shantaram Wasudev (assistant)	1884 1st April 1st April 1st Oct.	1884 31st Mar. 30th Sep. 31st Mar.	
Jacobabad . . .	Third	Ditto W. J. Campbell Surgeon B. N. Koyaji .	1884 23rd Mar. 1st April	1884 31st Mar. 31st Mar.	Babaji Rawoot . Shaikh Ali .	1884 1st April 26th Nov.	1884 25th Nov. 31st Mar.	
Bickaneer . . .	Ditto	No Superintendent .	1884 1st April 2nd Mar.	1884 1st Mar. 31st Mar.	Ram Lal .	1884 1st April	1884 31st Mar.	
Hyderabad (Sind) .	Ditto	Surgeon-Major H. M. Macbeth. Surgeon H. W. Stevenson . Surgeon-Major R. M. Craig .	1884 1st April 2nd Mar. 22nd Mar.	1884 1st Mar. 21st Mar. 31st Mar.	V. E. Nazareth Ramparsad Mohunsing Bhuraya Jullaya . S. Pais .	1884 1st April 10th Nov. 25th Feb. 1885	1884 30th Sep. 9th Nov. 24th Feb. 31st Mar.	
Bhuj . . .	Ditto	Surgeon W. A. Barren . Surgeon-Major W. Atkins . Surgeon W. A. Barren . Surgeon-Major F. Jones .	1884 1st April 17th July 17th Sep. 16th Oct.	1884 16th July 16th Sep. 15th Oct. 31st Mar.	Ganu Luxman . Gulabkhan . No observer . Solomon Ezekial .	1884 1st April 17th June 1st Oct. 15th Oct.	1884 16th June 30th Sep. 14th Oct. 31st Mar.	*Approximate dates. † Ditto date.
Mount Abu . . .	Ditto	Ditto C. White . Ditto R. H. Robinson .	1884 1st April 6th Mar.	1884 5th Mar. 31st Mar.	Bapal Mehta . J. Whitenbury S. K. Gadgil .	1884 1st April 1st June 17th July	1884 31st May 16th July 31st Mar.	

Names of the Superintendents and of the Observers who have officiated at the Observatories in Western India during the year 1884-85—contd.

STATION.	Class.	Superintendent.	PERIOD.		Observer.	PERIOD.		REMARKS.
			From	To		From	To	
Neemuch	Third	Surgeon-Major H. Staunard Surgeon C. E. Nichol Surgeon-Major E. C. R. Ward	1st April 1884 1st July 1885 24th Jan. 1885	30th June 1884 23rd Jan. 1885 31st Mar. "	T. Bachu.	1st April 1884	31st Mar. 1885.	
Indore	Ditto	Ditto	1st April 1884	31st Mar. "	Trimbakrao	1st April "	31st Mar. "	
Rajkot	Ditto	D. F. Keegan	1st April 1884	17th Feb. "	Keshav Gobind	1st April "	31st Oct. 1884.	
Surat	Ditto	Surgeon-Major S. B. Haliday Ditto J. Robb Ditto H. Atkins Ditto S. O. B. Banks Ditto H. Atkins Ditto S. O. B. Banks Ditto H. A. Lewis	18th Feb. 1885 1st April 1884 26th April " 8th July " 1st Nov. 1885 3rd Mar. 1885 19th Mar. 1884	31st Mar. 1885 10th April 1884 7th July " 31st Oct. 1885 2nd Mar. 1885 18th Mar. " 31st Mar. 1884	G. C. Moodliar Dhunjibhai Motabhai Luxminarayan Chhagaulal Harilal	1st Nov. 1884 1st April " 15th May 1884 16th Nov. "	31st Mar. 1885. 14th May 1884. 15th Nov. 1885.	
Akola	Ditto	Surgeon J. J. Moran Ditto R. B. Roe Ditto J. J. Moran Ditto T. Hume Ditto R. B. Roe Ditto T. Hume	1st April 1884 26th May " 27th Aug. 1885 1st April 1884 1st Sept. " 7th Nov. "	25th May 1884 26th Aug. 1885 31st Aug. 1884 6th Nov. 1885 31st Mar. 1885	Samuel Gregory	1st April "	31st Mar. "	
Amraoti	Ditto	Ditto	1st April 1884	31st Mar. 1885	Bukaram Pandurang S. Narsappa Bukaram Pandurang S. Narsappa Bukaram Pandurang Hiralal	1st April " 10th May " 10th June " 3rd Dec. 1885 26th Mar. 1885 1st April 1884	9th May 1884. 9th June " 2nd Dec. " 25th Mar. 1885. 31st Mar. " 31st Mar. "	
Chikalda	Ditto	Ditto	1st April 1884	19th April 1884	Shunker Ramrao	1st April "	6th May 1884.	
Buldana	Ditto	Ditto	1st April 1884	18th July 1885	Keshav Apaji Shunker Ramrao Mahomed Husen	7th May " 7th Aug. 1885 1st Mar. 1885	6th Aug. " 28th Feb. 1885. 31st Mar. "	
Malegaon	Ditto	Ditto	1st April 1884	15th Dec. 1884	Solomon Aaron Piraji Jadhav G. C. Moodliar	1st April 1884 13th April " 9th Sept. "	12th April 1884. 8th Sept. " 12th Sept. "	
Sholapur	Ditto	W. R. Scroggie, Esq., L.R.C.P.	1st April 1884	31st Mar. "	Piraji Jadhav Shaik Mahomed Guljar Sing	9th Sept. " 13th Nov. " 15th Nov. "	14th Nov. 1885. 31st Mar. 1885. 7th April 1884.	
Ratnagiri	Ditto	Surgeon H. McCalman	1st April 1884	31st Mar. "	Govind Narhar Balvant Luxman Mahadev Cuddum	1st April " 8th April " 17th July "	16th July 1884. 31st Mar. 1885. 1st April "	
Karwar	Ditto	R. G. C. Westbrooke, Esq.	1st April 1884	31st Mar. "	G. W. M. D'Arango	1st April "	31st Mar. "	
Zanzibar	Ditto	Surgeon J. Williams	1st April 1884	23rd Dec. 1884	Abdur Rehman Surgeon J. Williams	1st April " 1st Oct. "	30th Sept. 1884. 23rd Dec. "	
Calicut	{ Storm- warning service. }	Captain H. Richardson T. W. Barboza, Esq. Captain F. M. Gillham	1st April 1884 27th May " 5th July "	26th May 1885 4th July " 31st Mar. 1885	F. D. Rozario F. G. Ragooloo F. D. Rozario	24th Dec. " 1st April " 13th Oct. " 18th Oct. "	12th Oct. 1884. 17th Oct. " 31st Mar. 1885.	

APPENDIX G.

Extract from the Administration Report of the Meteorological Reporter to the Government of Madras for the year 1884-85.

The separation of the Madras Meteorological Office from the Madras Astronomical Observatory, which had been in contemplation for some time, took place on the 15th of January 1885, when the office was temporarily transferred to a small building in the Nungumbankum High Road; but, as the accommodation was insufficient, the office was again removed in May to a larger house, situated in Spur Tank Road, Egmore. This change necessitated an application to Government for sanction of a small monthly allowance for office rent, which was readily granted. The increase in the number of observatories under my administration, as also of the establishment; the contribution of books to the library; a larger supply of meteorological instruments in store, and the general increase of the work of the department during the last four years, rendered it essential for the Madras Meteorological Office to have better accommodation than could be provided at the Astronomical Observatory, and hence its transfer.

As a copy of the complete meteorological register, kept at the Madras Observatory, is regularly furnished to this office by the Government Astronomer, no proper thermometer shed has yet been erected, but a cage and complete set of instruments for learners is always at hand; and during the year under report, three assistants were taught to take meteorological observations, one of whom was appointed to Kurnool in September last.

Eleven of the observatories were inspected during the year, the remarks on which will appear under the headings of their respective stations.

Appended to this report are the usual tables showing the list of officers in charge, and assistants, &c., lists of instruments supplied and in store, and the expenditure of the department during the official year 1884-85. The list of instruments supplied is considerably larger, owing to the new observatory started at Rajahmundry and the increased number of the stations inspected. No changes were made in the time of taking the observations.

The following is a complete list of the observatories which furnish meteorological registers:—

Madras.	Cuddapah.	Negapatam.
Amini Divi.	Kurnool.	Rajahmundry.
Bangalore.	Madura.	Salem.
Bellary.	Mangalore.	Secunderabad.
Cochin.	Masulipatam.	Trichinopoly.
Coimbatore.	Mercara.	Wellington.

Amini Divi (Laccadives).—Since the appointment of the new assistant Syed Laul, there has been a decided improvement in the observations taken at this station; but owing to the interruption of communication with the Island during the south-west monsoon, the records from April to November did not reach the Madras office until January 1885.

On reduction of the observations the work proved satisfactory, and I anticipate better results in future from this observatory. It appears, however, that the assistant, who is a medical subordinate, had to go to Mangalore on the 26th of December 1884, where he was detained until the 22nd of April 1885, and as there was no one else in the Island able to read the instrument during his absence, the meteorological register had to be discontinued.

As soon as communication with the Island is re-established, I hope to make arrangements that will ensure the continuity of the observations, when the assistant is unavoidably absent on circuit duty. The inaccessibility of the Island for regular inspection is a great disadvantage, but an occasional visit does not seem to be an impossibility.

The thermometer shed was re-thatched, and the instruments appear to have been in fair order throughout the year.

Bangalore.—This observatory was inspected on the 18th of April 1884, when a teakwood thermometer cage, similar to those supplied to all the other stations, was substituted in the place of the open

board hitherto in use. The barometer was clean and in very good order, and the small room in which it is placed, being utilized entirely as a meteorological office, enables the assistant to work there undisturbed.

The thermometer shed is well situated on a nice open piece of ground in the hospital compound. The thatching was in fair condition, but there were open spaces of about 8 inches both above and below each of the side screens, and the framework of the shed and surrounding railings required painting: these defects were immediately rectified. The wet bulb thermometer was thickly coated with a deposit of lime, and though clean, and apparently in good order, the re-arrangement of the instruments in the cage necessitated my changing the dry and wet bulb, the maximum, and the dry and wet minimum thermometers.

A complete list of instruments supplied to the observatories of the Madras Presidency during the year, with the dates on which they were first used, will be found on pages ... and ... of this report.¹

The Casella anemometer supplied in September 1882 was working well, and the rain-gauge and sun and grass thermometers were properly placed and in good order.

The office records have been neatly and carefully kept, and the whole condition of the observatory was very satisfactory, reflecting credit upon the medical officer in charge and his assistant. The register was continuous throughout the year, and the observations were correctly reduced by the assistant, and forwarded to the Madras office a few days after the end of each month. In consequence of the increased accommodation required at the Bowring Hospital, the medical authorities applied to me to transfer the meteorological observatory to some other part of Bangalore; but after a considerable amount of correspondence on the subject, no convenient site seemed available, so the instruments have been allowed to remain in their old position.

The work of this observatory has been so steady and trustworthy since its commencement in November 1867, that it would be very undesirable to remove it, unless it is absolutely necessary.

Bellary.—The work of this second class observatory, consisting of the ordinary observations three times a day, *viz.*, at 10h., 16h., and 22h.; hourly observations on four days in each month, and the synoptic observations taken at the local time corresponding to 7 A.M. Washington mean time for the "United States International Weather Bulletin," was carried on steadily throughout the year, without any change in the instruments. The anemometer was out of order from the 5th to the 8th of October, and on the 13th of November 1884 it became quite useless and was taken down. With this exception, all the instruments were in good condition.

The two assistants have conducted their duties in a creditable manner, reducing their observations more accurately than in past years; but notwithstanding fines, the records and reductions have been withheld from the Madras office till three or four months after date. The probable transfer of the observatory to a better and more suitable site (mentioned in the last report) was unavoidably delayed, and until this change has been effected inspection has been deferred.

Cochin.—The observatory at this station was inspected on the 23rd of March 1885. The barometer occupies a very good position as regards light and safety on the southern wall in the Brigade-Surgeon's private office, but the mercury in the cistern was in a very oxidized state, the inside of the glass being coated round with a greenish film about half an inch deep. The brass scale and vernier were very discoloured, rendering it difficult for the assistant to see the divisions. I was unable to change the instrument as my store of barometers at Madras was exhausted; but when a new one has been procured, it will be well to have readings of both instruments taken hanging side by side, to enable us to ascertain any error caused by this defect.

The thermometer shed had just been painted, and was in excellent condition; the only imperfection being spaces of about 6 inches above instead of below each of the side screens; this was soon altered. The situation of the shed is favourable in many respects, although perhaps a little too much enclosed by the surrounding hospital buildings. The thermometers were clean and faultless, but on removing the board on which they had always been placed and erecting a cage instead, a re-arrangement of the instruments was necessary, and as the dry and wet bulb thermometers had not had their corrections verified for some years, I thought it a favourable opportunity for making a complete change. The only thermometer allowed to remain was the sun maximum, which was supplied in March 1882. I found the anemometer, as I expected, only about 16½ feet high, sheltered by higher buildings and surrounding trees. There are eight tall casuarina trees towering above every-

¹ In incorporated in Appendix K.

thing else in the hospital compound, not far from the observatory, and I suggested having one cut, and placing the instrument on the top, with a good strong ladder, to enable the assistant to take the readings; but the medical officer in charge showed me how hollow all the trees were, and as one had only very recently been blown down, he thought it would not be safe. There are no high buildings anywhere about Cochin, and the only place that the medical officer could recommend was the flag-staff in the Municipal Gardens. To place the instrument there, permission will have to be obtained of the Port Officer at Cochin, or of the Master Attendant at Madras; this will not be a difficult matter, and I hope soon to have the anemometer recording reliable measurements of the velocity of the wind at this station.

The rain gauge is placed in the hospital compound instead of within the enclosure as at most other observatories; it was in good order.

A very necessary addition to this observatory is a neat and useful fencing enclosing the shed, instead of the unsightly bamboos tied together to do duty for rails. The medical officer in charge promised to send me an estimate of the probable cost of wooden railings, but on receipt of it I found that for about the same price Messrs. Oakes & Co. of Madras would supply all that was needed, *viz.*, three rows of barb fencing posts and turn stile. This fencing is a sure preventive against cattle straying into the shed enclosure, a very necessary precaution at most of the well-kept observatories where the green grass around and the thatching on the roof of the shed are great temptations to the animals outside. No grass minimum thermometer has been in use owing to there not being any in store at Madras. The records of all the other instruments were continuous throughout the official year.

The assistant is careful and accurate in his reductions, and his work has reached the Madras office in good time each month. The general condition of the observatory was very satisfactory and creditable to the medical officer in charge and his assistant; none of the defects noted being attributable to any carelessness.

Coimbatore.—As the thermometer shed had just been painted and repaired when I inspected the observatory on the 18th of March 1885, I found it in excellent condition. No change had been made in the positions of the instruments since my last visit, and they were all in very good order.

A very necessary improvement at this observatory is a good high staging for the anemometer and wind vane, as there is no convenient building anywhere of a sufficient height near on which these instruments could be placed, and their positions of about 14 feet from the ground cannot afford reliable results.

The official records and papers belonging to the observatory were in good preservation. There have not been any breaks in the records throughout the year, and the assistant has reduced his observations accurately, and forwarded them to me punctually every month.

In consequence of the good service rendered by the assistant, his retirement has been deferred until the 31st of May 1885.

Cuddapah.—The thermometric observations were commenced at this new observatory on the 23rd of March 1884; but as there were no serviceable barometers, nor sun and grass thermometers on hand at Madras, I had to await the arrival of a fresh supply from Calcutta. On receipt of the instruments, I sent my head clerk in charge of a barometer and two radiation thermometers, which were brought into use on the 11th of April 1884. On placing the barometer in the observatory, Vythinathe Iyer found it in good order; but judging from the telegraphic readings received at Calcutta, the Meteorological Reporter to the Government of India informed me that, when compared with neighbouring stations, they appeared to be too low. A set of comparisons with the Madras Meteorological Office standard barometer will therefore be necessary, and I intend sending the head clerk there again as soon as possible.

The grass minimum thermometer had only been in use for six days when it was found broken, and on the 15th of September, when the observer went to read the instruments, the dry bulb of the hygrometer was missing; a search was immediately made, and the thermometer was found broken outside the hospital compound, evidently done out of sheer mischief. As the shed is in rather a public position, and there does not appear to be any one to guard the hospital compound, it was considered advisable not to use either sun or grass thermometers until better arrangements could be made for the safety of these instruments when exposed.

The assistant was fined for inattention to orders, but more particularly for troubling the Meteorological Reporter to the Government of India on matters regarding the observatory, which should have

been reported to the Madras office; the latter was a most inexcusable act of insubordination. A few extra posts had been sent to the observatory, and it was the duty of the assistant to have carried out the instructions received from my office, and to have kept the shed in proper order; instead of which he delayed the erection of the posts, and let the side screens fall into a state of dilapidation. I also desired the assistant to have a lock and key put to the cage, but this was not attended to. On the 17th of September the Madras Meteorological Office peon was sent to Cuddapah with a new dry bulb thermometer, and with instructions to stay there until he had seen the shed and fencing properly repaired.

The records have been continuous throughout the year, and the assistant appears to have taken the observations carefully.

The anemometer and wind vane have not been erected yet, owing to the difficulty of getting a suitable staging and ladder.

Kurnool.—It is with regret that I have to report that the work of this observatory was perfectly useless and unreliable until the appointment of a new assistant on the 21st of October 1884.

When I inspected the station on the 27th of August, I found the barometer clean, in good condition, and well placed, but it had been removed from its original position in the Telegraph Office to the signaller's room in the Post Office, on the amalgamation of the two departments. On asking the Post Master, who was also meteorological assistant, to set the barometer and take a reading, I found that, instead of adjusting the ivory point so that it nearly touched the mercury in the cistern, he thoroughly immersed it, and in setting the vernier, he left a complete line of light between it and the surface of mercury in the tube. I showed him exactly how to set the barometer and read the vernier, and after a little practice he improved. He was very willing and anxious to learn, but he said he could not possibly undertake to record an anemometer, as his combined duties of Postal and Telegraph Master were too much. I informed him that the anemometer must be erected as soon as possible, and that under the circumstances his best plan would be to resign the office of meteorological assistant, as he had already applied to me to be allowed to do. After a little reluctance however, he complied, and on my return to Madras, a new assistant was sent to take charge. No change had been made in the position of the shed since its erection, but it was in a very unsatisfactory state; the thatching on the roof only being about an inch and a half thick, and as there were no side screens, the thermometers were unsheltered from sunshine or rain. The muslin of the wet minimum thermometer was also very discoloured, evidently through impure water; but with this exception the remaining instruments were in fair order. I asked the Executive Engineer of the District to have the shed properly repaired, which he did soon after my visit. Owing to difficulties regarding a convenient position and platform for the anemometer, this instrument has not been put up. The sun maximum thermometer was found broken in October, and the readings of the dry maximum thermometer were erroneous in December. These instruments were therefore replaced by new ones.

As the Collector of Kurnool has very kindly offered to undertake the superintendence of the observatory, it is under consideration to remove the instruments to the Collectorate. I hope this change will be speedily carried out, as it will ensure satisfactory results in future.

Since the appointment of G. R. Paramaswara Iyer, there has been a great improvement, and the observations have been reliable.

Madura.—The Madura observatory was inspected on the 10th of March 1885. The surface of the mercury in the cistern of the barometer was in a state of oxidization, and required cleaning; but with this exception the instrument was in a fair condition.

The thermometer shed occupies a favourable position; it was well thatched and the side screens were properly fixed with spaces below to admit air. The dry and wet bulb thermometers required re-verification of their corrections, and most of the other thermometers were old but clean and in good order. The erection of a teakwood thermometer cage in the place of the board rendered it a favourable opportunity for changing the thermometers, which was accordingly done, with the exception of the sun maximum and grass minimum, which had only been lately supplied. The outer glass of the former instrument was very scratched, and the divisions on the latter thermometer were rather indistinct. The glass bottle and rain measure, belonging to the rain gauge, were both cracked.

I strongly objected to the untidy state of the compound in which the shed is situated, as being overgrown with shrubs, weeds, and high grass, it must in a measure obstruct the free circulation of the air. The assistant promised to have the grass cut and the compound cleared and made neat. The

anemometer and wind vane were in good positions and working order. The medical officer in charge was away when I visited the observatory, and the permanent assistant was also absent on sick leave. Generally speaking, when any of the highly paid assistants required leave, they have made arrangements with some one on the spot to carry on the duties; but V. Sashachellum Naidu has not done so, and I have been obliged to send assistants from the Madras office on two occasions, which has caused delay and great inconvenience at head-quarters.

The wet bulb thermometer was broken on the 9th of April 1884, and owing to there not being any on hand at Madras, I could not replace it until September. Breakages of instruments at this observatory, causing omissions in the records, have been a frequent source of complaint, and I think it has been partly due to carelessness. The assistant has not performed his duties as satisfactorily as I could have wished, owing probably to ill health which will very likely oblige him to retire before long.

Mangalore.—This station calls for no special remark beyond a few words of praise at the highly creditable way in which the Telegraph Master in charge of the observatory has conducted his meteorological duties throughout the year.

No new instruments have been required. The shed has been repaired when necessary, and the records have been forwarded to the Madras Meteorological Office with the greatest punctuality.

Masulipatam.—Continuous observations have been carried on at this observatory throughout the year; and with the exception of the barometer, the instruments appear to have been in fair order. The abnormally low barometric readings, when compared with those of past years and other stations, threw suspicion on the new instrument, and necessitated early inspection. As I had occasion to send my head clerk to Rajahmundry, it was a favourable opportunity for him to inspect the Masulipatam observatory, which he did on the 3rd and 4th of May 1884. He found the thermometers in good order, with the exception of the wet bulb of the hygrometer, the muslin and thread of which had evidently not been changed for some time.

On checking the records made by the assistant, Vythinathe Iyer found that they were carefully and accurately made; and the only conclusion arrived at concerning the barometer is that it must have got out of order during transit from Calcutta. Having asked Mr. Blanford to send me a new one, I hoped it would have reached Masulipatam before my head clerk left; but it did not arrive until the 16th of June, when it was immediately brought into use. Its readings appear to be correct.

The assistant only partially reduced his observations, and even the few months' registers that he attempted were not forwarded to the Madras Meteorological Office till about six months afterwards, when the work had been done by my office staff. Failing sight was his excuse, and this has since been confirmed by the medical officer in charge, who has reported him unable to see small figures. He has only been allowed half pay throughout the year, and his immediate retirement is necessary.

Mercara.—Everything at this station has been perfectly satisfactory throughout the year. The instruments appear to have been in good order. The observations have been carefully and accurately taken by the Telegraph Masters who have been in charge of the observatory, and the records have been forwarded to the Madras office with the greatest regularity. The thermometer shed was repaired before the commencement of the monsoon, and notice given that before long nearly all the posts will require renewing, an estimate for which was also forwarded. From information received lately, it seems under contemplation to amalgamate the Postal and Telegraph Offices, in which case the observatory will probably have to be removed.

Negapatam.—The barometric readings were unaccountably erroneous for some time; and as there were no good instruments in store at Madras, the Meteorological Reporter to the Government of India supplied a new one from Calcutta, which was brought into use on the 1st of August 1884. The wet bulb thermometer was reported useless from the 14th September 1884, and was replaced by another on the 16th of the same month.

A teakwood thermometer cage, similar to those in use at other observatories, was sent to Negapatam at the request of the medical officer in charge, who superintended its erection, and saw the instruments properly arranged. I inspected the observatory on the 13th of March 1885, and recorded the following remarks:—The position and condition of the barometer were all that could be desired. The thermometer shed occupies a good open position in the hospital compound. The side screens required moving to the centre of the shed, and raising a few inches at each side to shield the thermometers, and the telegraph wires enclosing the shed were a little slack.

These small requirements were immediately attended to. In every other respect the shed was in very good preservation. The thermometers were clean and in fair order, but old; and as I wished to have some of their corrections re-verified, I took this opportunity of changing all but the sun maximum and grass minimum thermometers. As the tube of the latter instrument had been reported cracked, a new one had been sent, but it was broken in transit; so on returning to Madras I despatched another, which has been in use since the 23rd of March 1885. The anemometer was in good order, but the letter S had come off the wind vane.

The Negapatam meteorological office in which the barometer is kept, and the assistant works, is exceedingly clean and tidy. The office records are neatly bound, and arranged on a small shelf put up for the purpose, and a fresh copy of Mr. Blanford's rules had just been procured and hung up.

The assistant has reduced his observations accurately and neatly throughout the year, and the registers have always reached me in excellent time.

The condition of the Negapatam observatory was most satisfactory and highly creditable to the medical officer in charge and his assistant. An observatory always fares better when the medical officer in charge is interested in the work and encourages his assistant, as in this case.

Rajahmundry.—A new third class observatory was opened at this station on the 23rd of May 1884.

To prevent any delay in the erection, and to ensure uniformity in the design and dimensions, a thermometer shed, similar to those in use throughout the Madras Presidency, with posts and turnstile for the enclosure, was constructed and despatched to Rajahmundry. The head clerk of the Madras Meteorological Office was sent in charge of a barometer and complete set of thermometers, and directed to see the shed put up, to arrange the instruments, and to teach an assistant the duties required. With the kind aid of the Public Works Department, the shed was put up, and all arrangements completed by the 20th of May 1885. The medical officer in charge of the Civil Dispensary has kindly undertaken to superintend the meteorological observatory, and the barometer has accordingly been placed in an office room belonging to the Dispensary; the height of its cistern above sea level being 112 feet. This instrument appears to have been roughly handled in transit from Calcutta, and was not in proper order on being unpacked. As soon as another can be produced it will be exchanged.

The thermometer shed is erected in the compound of the Civil Dispensary, and as far as I can judge from reports it is well situated. I hope soon to be able to visit the observatory at this station myself.

The posts and ropes round the shed were insufficient to prevent animals from intruding, and I have therefore supplied barb fencing, as at Cochin. The maximum thermometer was reported out of order some time ago, and has not yet been replaced. Pending the necessary structure for an anemometer, and the receipt of a fresh supply of wind vanes from Calcutta, these instruments have not been put up. The assistant's records appear to be taken with care.

Salem.—This station has fully maintained its good reputation throughout the year. When I inspected the observatory on the 26th March, I found everything in perfect order, and highly creditable to the medical officer in charge and his assistant. The only request I had to make was that a few tall casuarina trees not far from the anemometer might be topped, so that they should not interfere with the accuracy of the records of the wind velocity.

The assistant has reduced his observations carefully, and both records and reductions have invariably reached the Madras Meteorological Office in good time.

Secunderabad.—As stated in my last report, the shed at this observatory required painting and thoroughly repairing. This was accordingly done, and on inspecting the observatory on the 19th and 21st of August, I found everything highly satisfactory. The fencing had been extended right round the shed; and all the instruments were clean and in perfect order except the rain gauge, which required a new glass measure. I checked the 4 P.M. readings taken by the assistant, as I frequently do on these occasions, and found them very accurate. His work throughout the year has been all that could be desired.

Trichinopoly.—The thermometer shed had been painted and thoroughly renovated when I inspected the observatory on the 13th of March 1885.

A new turnstile, twenty posts and four rows of good iron wire had been put round the shed to prevent cattle from intruding. The old thermometer board was removed, and a teakwood cage

placed in its stead containing a set of new instruments, with the exception of a sun maximum thermometer which was not required. The dry and wet bulb hygrometer hitherto in use required re-comparing; all the other instruments were in good order, but the alteration of the arrangement rendered a complete change necessary. The anemometer platform and ladder are too weak to be safe; but as it is under consideration to change the place of this instrument, all extensive repairs have been deferred, and only the immediate wants attended to.

The mercury in the cistern of the barometer was slightly oxidized, but in other respects the instrument was in perfect order.

Trichinopoly being a second class station, ordinary observations have been recorded three times a day, *viz.*, at 10h., 16h. and 22h.; hourly observations on four days in each month, and the synoptic observations taken at the local time corresponding to 7 A.M. Washington mean time for the "United States International Weather Bulletin."

The register has been continuous, and the assistants have worked in a highly praiseworthy manner throughout the year. The records and reductions have reached the Madras office in better time, and everything has been satisfactory.

Wellington.—The work at this observatory has been quite satisfactory, and consequently calls for no special remarks.

The records and reductions have been carefully and accurately made and forwarded to my office with great regularity. No changes have been made in the instruments.

There has been a general improvement in the work of the Madras Presidency Meteorological Department during the official year 1884-85, and many thanks are due to the medical officers who have been in charge of the observatories for their able supervision and the general interest they have taken in the meteorology.

With the exception of the Post Master at Kurnool, who was inexperienced in reading instruments, and unable to attend this office for instruction, and the Telegraph Master at Mercara, who was transferred to another station, there have been no changes in the assistants. They have paid more attention to everything connected with their work, and the registers have been more accurately reduced and forwarded to me in better time.

Frequent inspection tends to arouse the interests of the assistants, and the observatories visited of late have been in more efficient order. There are often small defects, either in the instruments or the system of working, which are not noticeable to those in charge, but which immediately attract the attention of an Inspecting Officer. I also observe a marked difference in the condition of the observatories at which the medical officers in charge pay a little attention to the meteorology.

In checking the readings of each up-country assistant, I not only see whether they are accurate, but also their system of recording, whether they are quick or slow, &c. Owing to the insufficient accommodation for storing instruments when the Madras Astronomical Observatory and the Meteorological Office were in the same building, I have not hitherto had a sufficient supply of instruments to enable me to re-place, as speedily as I wished, any that were reported broken or defective.

The substitution of cages for thermometers in the place of the boards previously used will no doubt save the instruments; but even to the cages it has been found advisable to have locks and keys. Monkeys, jackals, and other animals frequently break the grass radiation thermometers, and in one or two cases their use on that account has been discontinued until some better arrangement can be made for their protection. At one or two of the Civil Dispensaries where the barometer is placed in a public room and the thermometer shed in a good open position, the instruments have been interfered with by mischievous individuals, and the medical officers have applied to me for watchmen. The supply of a particular kind of fencing will, I hope, prevent future difficulties of this kind. Most of the thermometer sheds have been repaired this year.

On the transfer of the Mercara observatory I am given to understand that a thorough renovation of the shed will be necessary. New anemometer stagings are urgently required at Cochin, Coimbatore, Cuddapah, Kurnool, Trichinopoly, and Rajahmundry, and as these are expensive items, their construction has been deferred until sanction can be obtained for the extra expenditure.

The work of the Madras Meteorological Office consisting chiefly of the revision of the records and registers received from observatories at which the assistants reduce their own observations; the reduction of the records of all the third class observatories; making extra copies for transmission to the Meteorological Reporter to the Government of India; preparing returns requested by other

Government Officials and the ordinary office daily routine, has been carried on by the same staff. Special attention was given to clearing up all arrears, and had it not been for sending two assistants away to up-country stations, it would have progressed more favourably.

The Revenue Board Rain Stations have not been handed over to me yet, but I believe it is in contemplation to do so at an early date.

* * * * *

ELIZABETH ISIS POGSON, F.R. MET. SOC.,

Meteorological Reporter to the Government of Madras.

METEOROLOGICAL OFFICE, MADRAS,

27th July, 1885.

APPENDIX G

List of Officers in charge, and Assistants, in the Madras Presidency Meteorological Department in the official year 1884-85.

Station.	Officer in Charge.	From	To	Assistant.	From	To
Madras	Miss E. Isis Pogson, F.R. MET. Soc., Meteorological Reporter and Assistant Government Astronomer.	25th July 1881	31st Mar. 1885	J. Vythenathe Iyer, 1st	1st Feb. 1878	31st Mar. 1885.
				N. E. Kangayam Pillay, 2nd	1st Mar. 1882	31st Mar. "
				G. Narayanasawmy Naidu, 3rd	18th Aug. 1883	31st Mar. "
				David John, 4th	1st Feb. 1884	31st Mar. "
Ammini Divi	Syed Laul.	6th Feb. 1884	31st Mar. "			
Bangalore	Surgeon-Major J. North	20th Feb. "	20th May 1884	Rungasawmy Moodeliar	1st Sep. 1871	31st Mar. "
	" A. F. Dobson, M.B.	21st May "	31st Mar. 1885			
Bellary	" H. M. G. Archdall	11th Feb. 1881	31st Mar. "	B. G. Sashachellum Naidu, 1st	31st Aug. 1878	31st Mar. "
				Sreenavasa Row, 2nd	21st Dec. 1881	31st Mar. "
Cochin	Brigade-Surgeon W. H. Morgan	24th May 1882	8th May 1884	M. V. Eippe	18th Aug. 1883	31st Mar. "
	Surgeon K. C. Sanjana	9th May 1884	5th Sep. "			
	Brigade-Surgeon W. H. Morgan	6th Sep. "	31st Mar. 1885			
Coimbatore	Surgeon-Major J. F. Fitzpatrick, M.D.	2nd May 1882	9th Mar. "	Varadiah Naidu	1st July 1877	31st Mar. "
	Surgeon S. C. Sarkies	10th Mar. 1885	31st Mar. "			
Cuddapah	" G. Iyasawmy	15th Mar. 1884	8th June 1884	V. A. Vijaravulu Moodeliar	15th Mar. 1884	31st Mar. "
	" M. J. Kelawala	9th June "	28th June "			
	" G. Iyasawmy	29th June "	31st Mar. 1885			
Kurnool	Post Master V. Venkataseshayya	20th Oct. 1883	20th Sep. 1884			
	G. R. Paramaswara Iyer	21st Sep. 1884	31st Mar. 1885			
Madura	Surgeon-Major W. J. Hastings, M.D.	16th Oct. 1883	12th May 1884	V. Sashachellum Naidu	19th Nov. 1867	31st Mar. "
	Surgeon J. Kernan	13th May 1884	31st July "			
	Surgeon-Major W. J. Hastings, M.D.	1st Aug. "	16th Oct. "			
	Surgeon G. M. E. McKee	17th Oct. 1883	21st Nov. "			
Madura	" F. C. Smith	22nd Nov. 1884	31st Mar. 1885			

List of Officers in charge, and Assistants, in the Madras Presidency Meteorological Department in the official year 1884-85—contd.

STATION.	Officer in charge.	From	To	Assistant.	From	To
Mangalore.	Telegraph Master R. S. D'Souza	10th Feb. 1884 .	17th April 1884 .			
	" F. D'Souza	18th April	31st Mar. 1885 .			
Masulipatam .	Surgeon-Major J. H. Ritchie	9th Nov. 1883 .	17th April 1884 .	Uma Ranganayakulu Naidu	19th Nov. 1867 .	31st Mar. 1885 .
	Surgeon F. J. Doyle	18th April 1884 .	25th Dec. "			
	Surgeon-Major J. B. Thomas, L.R.C.P.L.	26th Dec. "	31st Mar. 1885 .			
Mercara	Telegraph Master H. Duckworth	29th Mar. 1880 .	3rd April 1884 .			
	Depy. Tel. Master T. S. Arunachallum	4th April 1884 .	18th April "			
	Telegraph Master H. Duckworth	19th April "	15th Oct. "			
	Depy. Tel. Master T. S. Arunachallum	16th Oct. "	31st Mar. 1885 .			
Negapatam . . .	Surgeon E. A. Morris, L.R.C.P.L.	15th Nov. 1880 .	11th Nov. 1884 .	S. Saminatha Iyer	5th Sep. 1874 .	31st Mar. "
	Surgeon H. St. C. Carruthers	12th Nov. 1884 .	31st Mar. 1885 .			
Rajahmundry . .	Surgeon E. Levinge	15th May "	31st Mar. "	A. Mukanda Row Naidu	15th May 1884 .	31st Mar. "
Salem	Surgeon-Major A. L. Hackett	29th Dec. 1883 .	18th April 1884 .	L. Ramsing	13th Oct. 1880 .	31st Mar. "
	Surgeon-Major J. L. Ratton	19th April 1884 .	20th Feb. 1885 .			
	Surgeon J. Kernan	21st Feb. 1885 .	31st Mar. "			
Secunderabad . .	Surgeon-Major T. C. H. Spencer	15th Dec. 1882 .	22nd Mar. "	J. T. Williams	27th Feb. 1882 .	31st Mar. "
	Surgeon G. F. Bevan	23rd Mar. 1885 .	31st Mar. "			
Trichinopoly . .	Surgeon-Major L. C. Nanney, M.D.	27th July 1883 .	13th April 1884 .	T. Lutchman Row, 1st	21st Nov. 1874 .	31st Mar. "
	Surgeon A. M. Rogers-Harrison	14th April 1884 .	30th June "	E. M. Bhojarajooloo Naidu, 2nd	1st Dec. 1881 .	31st Mar. "
	Surgeon-Major L. C. Nanney, M.D.	1st July "	31st Mar. 1885 .			
	Surgeon-Major C. F. Churchill, M.D.	17th Nov. 1883 .	10th Jan. "	H. Brownell	1st Aug. 1880 .	31st Mar. "
Wellington . . .	Surgeon-Major W. G. Grant	20th Jan. 1885 .	31st Mar. "			

APPENDIX H.

Administration Report on the Meteorological Observatories by the Sanitary Commissioner, British Burma, for the year 1884-85.

Since the submission of previous report, all the observatories in the province have been inspected by me.

The leaf roof of the thermometer shed at Rangoon was too thin, and admitted direct rays of heat and light somewhat freely. The aneroid [anemograph?] had been removed for repairs, but has since been replaced. The other instruments were *in situ*, and appeared in good working order.

At Bassein, Moulmein, and Mergui the meteorological instruments and records were found, the former in order, and the latter correct and up to date. The several superintendents spoke favourably of their observers.

The attention of the Executive Engineer was invited to the state of the wind vane at Thyetmyo which did not work easily or smoothly. Otherwise the instruments and records connected with this observatory were found in a satisfactory condition.

At Toungoo during my visit the stand for the wind gauge and vane was under construction. The new thermometer stand had been completed, and occupies a fairly good position near the dispensary; the removal of several trees in the vicinity was recommended. Records carefully kept by Hospital Assistant Shaik Hydiat Ally who was highly commended by the superintendent.

The accompanying lists show:—

- (a) The superintendents and observers for the year.
- (b) The instruments issued to each observatory.¹

D. SINCLAIR, M.B.,
Sanitary Commissioner, British Burma.

¹ Incorporated in Appendix K.

APPENDIX H I.

Return showing the names of Superintendents and Observers of the Meteorological Observatories in British Burma for the year 1884-85.

STATION.	Class.	Superintendents.	PERIOD.		Observers.	PERIOD.	
			From	To		From	To
Rangoon .	Second	Surgeon-Major H. Johnstone, M.D. .	1st April 1884 .	31st Mar. 1885 .	G. E. Wales, Observer . . .	1st April 1884 .	31st Mar. 1885.
Bassein .	Ditto	Surgeon S. H. Dantra . . .	1st April .	3rd Dec. 1884 .	O. White, Assistant Observer . .	1st April .	31st Mar. .
		Chand Khan, Hospital Assistant .	4th Dec. .	5th Dec. .	Moung Hpay . . .	1st April .	31st Mar. .
		Surgeon P. W. Dalzell . . .	6th Dec. .	3rd Mar. 1885 .			
		Surgeon S. H. Dantra . . .	4th Mar. 1885 .	31st Mar. .			
Thyetmyo .	Third	Surgeon C. W. E. Foster . . .	1st April 1884 .	25th May 1884 .	Alla Deen, Hospital Assistant . .	1st April .	31st Mar. .
		Surgeon E. P. Frenchman . . .	26th May .	14th Mar. 1885 .			
		Surgeon P. W. Dalzell . . .	15th Mar. 1885 .	31st Mar. .			
Moulmein .	Ditto	Brigade-Surgeon W. F. de Fabeck, M.D. .	1st April 1884 .	31st Mar. .	F. St. Hilbert Hospital Assistant .	1st April .	31st Mar. .
Mergui .	Ditto	Mr. P. G. Paul . . .	1st April .	31st Mar. .	Moosajee . . .	1st April .	31st Mar. .
Toungoo .	Ditto	Surgeon P. W. Dalzell . . .	1st April .	19th Nov. 1884 .	M. Baboo, Hospital Assistant . .	1st April .	30th April 1884.
		Surgeon M. Smith . . .	20th Nov. .	31st Mar. 1885 .	Shaik Hydiat Ally, Hospital Assistant .	1st May .	31st Mar. 1885.

D. SINCLAIR, M.B.,
Sanitary Commissioner, British Burma.

APPENDIX I.

Return of the Stock Receipt and Issue of Instruments for the year 1884-85.

Instruments.	In Store on 1st April 1884.	Received 1884-85.	Issued 1884-85.
Van Rysselberghe's meteorograph	1	...	...
Barometers, observatory, Fortin's principle	10	10	12
Do. do. Kew principle	8	6	8
Do. mountain, portable tripod (Adie)	10	11	1
Do. marine, Kew principle	6	17	3
Do. Newman's large standard	2	...	...
Do. do. small standard	2	1	...
Do. Negretti and Zambra (various)	5	2	...
Aneroids	19	3	4
Thermometers standard with attached scales	17	2	3
Do. without attached scale (chemical)	1	...	...
Do. for hygrometers (Kew pattern)	69	6	39
Sling thermometers	10	...	3
Thermometers, maximum, for shade	87	20	39
Sun thermometers not in vacuo	2	...	...
Thermometers, minimum, for shade	47	19	33
Do. do. radiation	22	23	31
Six's thermometers	6	...	...
Thermometers solar in vacuo (self-registering)	35	5	31
Do. do. (non-self-registering)	21	...	...
Frankland's sun thermometers	5	...	2
Ponillet's pyrheliometer	1	...	...
Stewart's actinometers (thermometers for) . . . . .	...	13	6
Do. do. (chamber for) . . . . .	...	1	...
Hodgkinson's actinometers	2	...	...
Herschell's do.	1	...	...
Regnault's hygrometers	3	...	...
Daniell's do.	10	...	...
Halleur's do.	5	...	...
Boiling point thermometers	7	...	...
Pocket spectroscopes (Browning's)	2	...	...
Wind vanes	7	1	8
Anemometers	28	18	28

Return of the Stock Receipt and Issue of Instruments for the year 1884-85—contd.

Instruments.	In Store on 1st April 1884.	Received 1884-85.	Issued 1884-85.
Beckley's anemographs	2	1	3
Rain-gauges (Symons' and Glaisher's)	12	52	15
Measure glasses for do.	35	...	25
Reading lenses	1	2	1
Sun thermometer stands	14	...	10
Radiation pads . . . . .	...	8	6
Thermometer cages	3	12	12
Do. do for ships	15	...	1
Prismatic compass	1	...	...
Magnetic do. . . . .	...	1	1
Sand glasses (3 minutes)	46	...	3
Sunshine recorders	1	2	...
Bull's eye lanterns	1	...	1
Salinometers	36	...	1
Common thermometers, brass scales	27	...	...
Clocks	2	9	11
Watch	1	...	1
Spirit level	1	...	...
Hicks barograph	1	...	...
Thermograph with Negretti and Zambra's sets of recording thermometers	1	...	...
Electrophorus	1	...	...
Nephoscope . . . . .	...	1	1
Electrical anemometer and wind vanes . . . . .	...	3	...
Filled tubes for marine Kew principle barometer . . . . .	...	12	...
Do. observatory do. do.	13	...	5

APPENDIX K.

Return of the Instruments issued to each Observatory in 1884-85.

Province.	STATION.	HYGRO-METER.		MINIMUM THERMO-METER.	RADIATION THERMO-METER.	Anemometer	Wind Vane.	Rain-gauge.	Measure-glass.	Lenses.	Clock	Sand-glass.	Stand for sun thermo-meter.	Pad for grass radiation thermometer.	Cages.	Anemograph, Beckley's.	Aneroid.	Standard thermometer.	Sling thermometers.	Bull's eye lantern.	Actinometer thermometer.	Nephoscope.	Bottle for wet bulb thermometer.	Frankland sun thermo-meter.	REMARKS.
		Barometer.	Dry bulb.	Wet bulb.	Dry Maximum thermometer.	Dry.	Wet.	Solar.	Grass.																
AFRICA.	Zanzibar	2*	* In lieu of one broken.
	Aden . . .	...	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bushire . . .	...	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Quetta . . .	...	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Leh . . .	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
CASHMERE.	Chamba . . .	I	2	Original furniture.
	Pedong . . .	I	I	I	I	I	I	...	...	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...
	Lahore . . .	...	2	2	2	2	2	3†	2	I	I	I	2	...	I	I	I	...	...	...	...	...	...	...
	Peshawar . . .	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Rawalpindi . . .	...	...	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
PUNJAB.	Murree	† One non-self-registering
	Sialkot . . .	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ludhiana . . .	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sirsa . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Delhi . . .	I	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
N. W. PROVINCES AND OUDH.	Simla	I	...	I	‡ To be used as surface thermometer.
	Allahabad { Old . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	{ New . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Agra . . .	...	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Lucknow . . .	...	...	...	...	...	...	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
ASSAM.	Ranikhet	§ K. P. observatory bars sent to replace marine barometers.
	Bareilly . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Benares . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Meerut . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Dehra . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BENGAL.	Sibsagar	§ K. P. observatory bars sent to replace marine barometers.
	Dhubri . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Tezpor . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Alipore . . .	...	I	I	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Patna . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BENGAL.	Hazaribagh	§ K. P. observatory bars sent to replace marine barometers.
	Saugor Island . . .	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Cuttack . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Chittagong . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Darjeeling . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Berhampore . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Burdwan . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Jessore . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	False Point . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Midnapore . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BENGAL.	Noakhally . . .	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Burrisal . . .	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Serajgunj . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Comilla . . .	I	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

** In lieu of one withdrawn for re-examination.
†† In lieu of one broken.

Return of the Instruments issued to each Observatory in 1884-85—concluded.

Province.	STATION.	HYGRO-METER.		MINIMUM THERMO-METER.	RADIATION THERMO-METER.	Anemometer.	Wind vane.	Rain-gauge.	Measure-glass.	Lenses.	Clock.	Sand-glass.	Stand for sun thermometer.	Pad for grass radiation thermometer.	Cage.	Anemograph, Beckley's.	Anemoid.	Standard thermometer.	Sling thermometer.	Bull's eye lantern.	Actinometer thermometer.	Nephoscope.	Bottle for wet bulb thermometer.	Salinometer.	REMARKS.
		Barometer.	Dry bulb.	Wet bulb.																					
MADRAS, MYSORE, AND COORG.	Gopalpur	Original furniture.
	Trichinopoly . . .	...	1	1	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Cochin . . .	...	1	1	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Masulipatam . . .	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Madura . . .	...	1	2	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Salem . . .	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...
	Wellington . . .	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...
	Negapatam . . .	1	1	2	1	1	1	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...
	Bangalore . . .	...	1	1	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Kurnool . . .	...	...	...	1	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...
	Cuddapah . . .	1	1	...	...	...	1	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
	Rajamundry . . .	1	1	1	1	1	1	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mercara . . .	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...
BRITISH, BAY IS., LAND, BURMA.	Rangoon . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Toung-hoo . . .	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Akyab . . .	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...
	Nancowry . . .	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	S. S. Calcutta . . .	1	1	1	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...
	F. L. V. Foam . . .	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ajmere (Forest Dept.) . . .	...	2	3	3	2	2	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...
	Afghan Boundary Commission . . .	...	...	...	3	2	1	...	...	...	...	...	...	...	...	...	1	...	3	...	...	...	...	...
	Simla Office . . .	...	...	...	...	...	...	...	2	2	...	...	...	...	...	...	1	...	...	...	...	...	...	...
	Cinchona plantation, Madras . . .	...	1	1	1	2	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Simla (Deputy Commissioner) . . .	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Meteorological Office, Bengal . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...
	Mathematical Instrument Dept. . . .	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mr. W. L. Dallas . . .	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1

APPENDIX L.

List of Recipients of the Publications of the Meteorological Office.

Adelaide	Meteorological Observatory.
Agra	The Editor of the <i>Delhi Gazette</i> .
Ajmere	Chief Commissioner of Ajmere.
Akola	Sanitary Commissioner for Berar.
Algeria	Director of the Meteorological Service of the École des Sciences d'Alger.
	Secretary to the Government, North-Western Provinces and Oudh.
	Department of Revenue and Agriculture, North-Western Provinces and Oudh.
Allahabad	Meteorological Reporter, North-Western Provinces and Oudh.
	Sanitary Commissioner, ditto ditto.
	Editor of the <i>Pioneer</i> .
Amsterdam	Royal Academy of Sciences.
Bangalore	Chief Commissioner, Mysore and Coorg.
	Conservator of Forests, Mysore and Coorg.
Batavia, Java	Meteorological Observatory.
Berlin	Ditto Institute.
	Secretary to the Government of Bombay.
	Meteorological Reporter for Western India.
	Colaba Observatory.
	Sanitary Commissioner with the Government of Bombay.
Bombay	Bombay University.
	Asiatic Society of Bombay.
	Sassoon Mechanic's Institute.
	Geographical Society of Bombay.
	Editor of the <i>Bombay Gazette</i> .
	Ditto <i>Times of India</i> .
	Elphinstone College.
Brisbane, Queensland	Observatory.
Brussels	Royal Academy of Sciences.
	Observatoire Royal.
Bucharest, Roumania	Meteorological Institute.
Budapesth	Observatory.
	Secretary of State for India (through Revenue and Agricultural Department).
	Secretary to the Government of India, Revenue and Agricultural Department.
	Ditto ditto Home Department.
	Ditto ditto Public Works Department.
	Ditto ditto Foreign Department.
	Ditto ditto Department of Finance and Commerce.
	Ditto ditto Military Department.
	Private Secretary to His Excellency the Viceroy.
	Secretary to the Government of Bengal, Revenue Department.
	Meteorological Reporter to the Government of Bengal.
	Surveyor General of India.
	Superintendent, Geological Survey of India.
Calcutta	Sanitary Commissioner with the Government of India.
	Ditto ditto ditto Bengal.
	Superintendent, Botanical Gardens, Calcutta.
	Inspector-General of Forests, with the Government of India.
	Surgeon-General ditto ditto.
	Asiatic Society of Bengal.
	Indian Museum Library.
	Calcutta University.
	Presidency College.
	Public Library.
	Editor of the <i>Calcutta Review</i> .
	Ditto <i>Statesman and Friend of India</i> .

List of Recipients of the Publications of the Meteorological Office—continued.

	Editor of the <i>Englishman</i> .
	Ditto <i>Indian Daily News</i> .
	Ditto <i>Hindu Patriot</i> .
	Ditto <i>Indian Agriculturist</i> .
Calcutta— <i>contd.</i>	St. Xavier's College Observatory.
	The Alipore Observatory.
	Mint Master.
	Indian Association for the Cultivation of Science.
Cambridge	University Library (through H.M.'s Secretary of State for India).
Cambridge, Massachusetts	Harvard University.
Cape of Good Hope	Astronomer Royal.
Carlsruhe, Baden, Germany	Bureau für Meteorologie und Hydrographie.
Chemnitz	Royal Meteorological Institute.
Chatham	Royal Engineers' Library (through Revenue and Agricultural Department).
Christiania	Norske Meteorologiske Institut.
	Royal Observatory.
	Editor of the <i>Ceylon Times</i> .
Colombo	Ditto <i>Ceylon Observer</i> .
	Surveyor General of Ceylon.
Constantinople	Observatoire Impérial Météorologique.
Copenhagen	Danske Meteorologiske Institut.
	Royal Danish Academy of Sciences.
	Meteorological Office.
Cordoba	National Academy of Science.
Darjeeling	Conservator of Forests, Government of Bengal.
	Editor of the <i>Indian Forester</i> .
Dehra Dun	Superintendent, Great Trigonometrical Survey.
Dharwar	Conservator of Forests, Bombay, Southern Division.
Dublin	Royal Dublin Society.
Dacca	Dacca College.
	Scottish Meteorological Society.
Edinburgh	Astronomer Royal for Scotland, Royal Observatory.
Ellichpore	Assistant Conservator of Forests, Melghat Division.
Goa	Royal Observatory.
Greenwich	Astronomer Royal, Royal Observatory.
Guatemala	Observatorio Meteorologico del Institut Nacional de Guatemala.
	Nord Deutsche Seewarte.
Hamburgh	Deutsche Meteorologische Gessellschaft.
Havana	Real Collegio de Belen.
Hong-Kong	Observatory.
Indore	Agent to the Governor General for Central India in charge of the Residency.
Iowa, U. S.	Iowa Weather Service.
Jeypore	Maharajah's Observatory.
Jubbulpore	Civil Surgeon of Jubbulpore.
Katmandu	Resident at Nepal.
Khandwa	Civil Surgeon of Nimar.
Kitzingen, Bavaria	Dr. Emil Von Schlagintweit.
Kurrachee	Conservator of Forests, Bombay, Sind Division.
	Secretary to the Government of the Punjab.
	Meteorological Reporter ditto ditto.
	Sanitary Commissioner ditto ditto.
	Conservator of Forests ditto ditto.
	Editor of the <i>Indian Public Opinion</i> .
Leeds	Yorkshire College (through H. M.'s Secretary of State for India).
	Observatoire de Infante d'Luiz.
Lisbon	Academy of Sciences.
	Meteorological Council.
	Royal Society.
London	Royal Asiatic Society (through H.M.'s Secretary of State for India).
	Northbrook Indian Club (through H. M.'s Secretary of State for India).

List of Recipients of the Publications of the Meteorological Office—continued.

London— <i>contd.</i>	Society of Arts.
	Institution of Civil Engineers.
	Royal School of Mines.
	Royal Meteorological Society.
	Admiralty Library.
	United Service Museum.
	British Museum (through H. M.'s Secretary of State for India).
	Athenæum Club.
	Editor of the <i>Philosophical Magazine</i> .
	Ditto <i>Athenæum</i> .
	Ditto <i>Nature</i> .
	Ditto <i>Symon's Monthly Meteorological Magazine</i> .
	Ditto <i>Westminster Review</i> .
	Ditto <i>Quarterly Review</i> .
Madras	Secretary to the Government of Madras.
	Ditto ditto Public Works Department.
	Meteorological Reporter to the Government of Madras.
	Government Astronomer, Madras.
	Sanitary Commissioner, Government of Madras.
	Madras University.
	Editor of the <i>Madras Times</i> .
	Ditto <i>Madras Athenæum</i> .
	Ditto <i>Madras Mail</i> .
	Superintendent, Government Central Museum.
	Agricultural Reporter, Government of Madras, Saidapet.
	Surgeon General, British Medical Department.
	Ditto Indian Medical Department.
	Master Attendant of Madras.
Madrid	Conservator of Forests, Northern Circle.
	Royal Observatory.
	Magdeburgh Observatory of the Magdeburgh Zeitung.
	Manchester Literary and Philosophical Society.
Manila	Meteorological Observatory.
	Mauritius Meteorological Society.
Melbourne, Victoria	Observatory.
	University Library.
	Public Library.
Mexico	Central Meteorological Observatory.
Milan	Royal Astronomical Observatory.
	Royal Observatory.
	Royal Bavarian Academy of Sciences.
Munich	Geographical Society.
	Chief Commissioner, Central Provinces.
	Sanitary Commissioner ditto.
	Inspector General of Education, Central Provinces.
Nagpur	Superintendent, Meteorological Observatory.
	Conservator of Forests, Central Provinces.
	Ditto ditto North-Western Provinces and Oudh.
Nainital	Connecticut Academy of Arts and Sciences.
	Editors of the <i>American Journal of Science</i> .
New Haven, Connecticut	Central Park Observatory.
New York, U. S.	Sub-Divisional Officer.
Nowgong-Rajshahye	Conservator of Forests, Government of Madras.
	Editor of the <i>South of India Observer</i> .
Ootacamund	Radcliffe Library.
	Radcliffe Observatory.
	Observatoire Physique Central de Montsouris.
Oxford	Editor of <i>La Nature</i> .
	Physical Observatory, Meudon.
	Bureau Central Météorologique.
	Meteorological Society of France.
Paris	

List of Recipients of the Publications of the Meteorological Office—concluded.

Perpignan, France	Commission Météorol. des Pyrénées Orientales.
Perth, W. Australia	Surveyor General.
Pesaro, Italy	Royal Observatory.
Philadelphia	Franklin Institute.
Poona	Conservator of Forests, Bombay, Northern Division.
Prag, Bohemia	Observatory.
Raipur	Civil Surgeon of Raipur.
	Chief Commissioner, British Burma.
Rangoon	Sanitary Commissioner, ditto.
	Conservator of Forests, ditto.
	Editor of the <i>Rangoon Times</i> .
Rome	Meteorological Office (Ministry of Agriculture).
Rio de Janeiro	Imperial Observatory.
Shaharunpore	Superintendent, Botanic Gardens.
Secunderabad	Secretary to the Resident at Hyderabad.
Shillong	Chief Commissioner of Assam.
	Conservator of Forests, Assam.
Simla	Assistant Quarter-Master General, Intelligence Branch.
Singapore	Principal Civil Medical Officer, Straits Settlements.
Stockholm	Nautisk Meteorologiska Byran.
St. Petersburg	Observatoire Physique Central.
	Geographical Society of Russia.
Strasburg	Imperial University Library.
Stonyhurst	Stonyhurst College Observatory.
Sydney	Observatory.
	University Library.
Syracuse, Sicily	Royal Meteorological Observatory.
Tasmania	Royal Society.
Tiflis, Russia	Physical Observatory.
Tokei, Japan	Imperial Mining Office.
	Imperial Meteorological Observatory.
Toronto, Canada	Magnetical and Meteorological Observatory.
Turin	Royal Astronomical Observatory.
Upsala	Meteorological Observatory.
Utrecht	Royal Dutch Meteorological Institute.
	K. K. Central-Anstalt für Meteorologie und Erdmagnetismus.
	K. K. Geologische Reichsanstalt.
Vienna	Imperial Academy of Sciences.
	Dr. J. Hann.
Vizagapatam	A. V. Nursingrow, Esquire.
	Chief Signal Officer, United States Army.
	Smithsonian Institution.
Washington, U. S.	Naval Observatory.
	Hydrographic Office.
	Professor Cleveland Abbe, Signal Office.
	United States' Geological Survey.
Wellington, New Zealand	Observatory.
Woolwich	Royal Artillery Library.
Zi-ka-wei, Shanghai	Magnetical and Meteorological Observatory.
Zurich	Central Meteorological Institute.

APPENDIX M.

Presentations to the Library from the 1st April 1884 to the 31st March 1885.

Place.	Donors.	Title of Work.
ADELAIDE . . .	Meteorological Observatory .	{ Meteorological observations made at the Adelaide Observatory and other places in South Australia, and the Northern Territory during the year 1881.
ALGIERS . . .	Meteorological Service .	{ Bulletin Météorologique du Gouvernement général de l'Algérie; 26th March and 27th October 1883; 16th January 1884 to 15th February 1885, (wanting 1—15th November 1884.)
ALLAHABAD . .	Meteorological Office . . .	{ Sketch of the Meteorology of the year 1883 in the North-Western Provinces and Oudh and Eastern Rajputana.
AMSTERDAM . .	Royal Academy of Sciences .	{ Processen-Verbaal, 1882-83. Jaarboek, 1882. Verslagen en Mededeelingen Afd Natuurkunde. Tweede Reeks, Volume XVIII.
BATAVIA. . .	Magnetical and Meteorological Observatory.	{ Rainfall in the East Indian Archipelago, 5th year, 1883.
BERLIN . . .	{ Dr. G. Hellmann Prussian Statistical Bureau . .	{ Grösste Niederschlagsmengen in Deutschland. Preussische Statistik LXXVIII, Ergebnisse der meteorogischen Beobachtungen im Jahre, 1883.
BOMBAY . . .	Government of Bombay . . .	{ Bombay magnetical and meteorological observations, 1879 to 1882, with five appendices. Twelfth Annual Report of the Sanitary Commissioner for the Government of Bombay for 1883, with appendices.
BRISBANE . . .	Robert L. Jack, Esquire . . .	{ Bombay Gazetteer, Vols. VIII, XXI, XXII & XXIII. Report on the Tin Mines of Herberton, Western and Thomson's Creek Districts, and the Silver Mines of the Dry River, Queensland.
BRUSSELS . . .	Observatoire Royal de Bruxelles	{ Diagrammes du Météorographe van Rysselberghe. Observatoire Royal de Bruxelles, 1879, 1880, 1881, 1882. Vade-Mecum de l'Astronome. Observations météorologiques faites aux stations internationales de la Belgique et des Pays Bas, Quatrième Année, 1880. Annuaire de l'observatoire Royal de Bruxelles, 1882, 1883, 1884.
BUCHAREST (Roumania)	Meteorological Service . . .	{ Exposition critique de la méthode de Wronski pour la resolution des problèmes de mécanique celeste. Première-Partie.
	Comptroller-General . . .	{ Review of the meteorological services in Europe.
	Geological Survey of India . .	{ Civil Estimates, 1884-85. Records, Vol. XVII, parts 2 and 4; Vol. XVIII, part 1. Memoirs, Vol. XXI, parts 1 and 2.
CALCUTTA . . .	Government of Bengal . . .	{ Returns of the rail-borne traffic of Bengal during the quarters ending 31st December 1883, 31st March, 30th June, and 30th September 1884. Report on the Internal Trade of Bengal for the year 1883-84. Report on the External Trade of Bengal with Nepal, Sikkim and Bhutan for the year 1883-84.
	Government of India, Home Department.	{ Report of the Meteorological Council of the Royal Society for the year ending 31st of March 1883. Progress Report of the Forest Administration in Ajmere-Merwara for 1883-84.
	Government of India, Revenue and Agricultural Department.	{ Journal of Indian Art, No. 2. Report of the census of British India taken on the 17th February 1881, Vols. I and III. Meteorological observations made at the Hon'ble East India Company's Magnetical Observatory at Singapore in 1841 to 1845.

Presentations to the Library from the 1st April 1884 to the 31st March 1885—continued.

Place.	Donors.	Title of Work.
CALCUTTA— <i>contd.</i>	Government of India, Revenue and Agricultural Department.	Report on the condition and proceedings of the Government Observatory, Colaba, for the year ending 30th June 1884.
		Note on the Census of British India in 1881.
		Return of the storms which have visited the British Islands between 1st January 1874 and 31st December 1883, and of which no warning has been issued from the Meteorological Office, London, with a notice of the quarter from which each unwarned storm has reached the coast.
		Administration Report upon the Madras Observatory for 1883.
		Report of the Indian Famine Commission, Appendix, Vol. III, Chap. I.
		Civil Travelling Allowance Code, Second Edition.
	Henry F. Blanford . . .	Report on the Mysore Census of 1881.
		Remarks on the autographic trace of the Calcutta barograph from the 26th to 30th August 1883.
	Meteorological Office, Bengal .	The Theory of the Winter Rains of Northern India.
		Report on the Administration of Bengal, 1883-84.
	Sanitary Commissioner with the Government of India.	Tenth Annual Report of the Sanitary Commissioner with the Government of India for 1873.
		Twentieth Annual Report of the Sanitary Commissioner with the Government of India for 1883.
CAPE OF GOOD HOPE .	Meteorological Commission . .	Cholera: What can the State do to prevent it?
		Meteorological observations taken at the St. Xavier's College Observatory, January to June 1884.
CARLSRUHE . . .	Bureau für Meteorologie und Hydrographie.	General Report on the Operations of the Survey of India Department during 1882-83.
CHEMNITZ . . .	Royal Meteorological Institute	Report of the Meteorological Commission for the year 1883.
		Jahres-Bericht des Centralbureaus für Meteorologie und Hydrographie im Grossherzogthum Baden nebst den Ergebnissen der meteorologischen Beobachtungen und der Wasserstandsaufzeichnungen am Rhein und an seinen grössern Nebenflüssen für das Jahr, 1883.
		Jahrbuch, 1883.
CHRISTIANA . . .	Norske Meteorologiske Institut .	Decaden Berichte, 1883.
COLOMBO . . .	Surveyor General of Ceylon . .	Wetterbericht, 1883, July 22nd to December 31st.
COPENHAGEN . .	Institut Météorologique Danois	Jahrbuch des Norwegischen Meteorologischen Instituts für 1883.
		The Meteorology of Ceylon in 1882 and 1883, and average results from 1869.
	Royal Danish Academy of Sciences	Bulletin météorologique du Nord, February 1884 to January 1885.
CORDOBA . . .	National Academy of Science .	Resumé des travaux de l'expédition polaire Danoise Internationale.
		Oversigt No. 3 of 1883; No. 1 of 1884.
		Boletin de la Academia Nacional de Ciencias en Cordoba (Republica Argentina) Tomo VI, Tomo VII Entrega 1ª and 2ª.
		La variabilidad interdiurna de la temperatura en algunos puntos de la republica Argentina de America del sud en general, parts I and II.
		Ideas sobre una exploracion sistematica del clima de la provincia de Cordoba sin instruments.
DEHRA DUN . . .	The Editor	Actas de la Academia Nacional de Ciencias en Cordoba Tome V, Entrega primera.
		Observations météorologiques faites a Cordoba (Republique Argentine) pendant l'année 1883.
		The Indian Forester, Vol. X, Nos. 4 to 12; Vol. XI, Nos. 1 to 3.
DETROIT, MICH .	Trigonometrical Branch, Survey of India.	Synopsis of the results of the operations of the Great Trigonometrical Survey of India, Vols. XVII to XXI.
	The Publishers	The American Meteorological Journal, Vol. I, No. 1.

Presentations to the Library from the 1st April 1884 to the 31st March 1885—continued.

Place.	Donors.	Title of Work.
DORPAT . . .	Meteorological Observatory . .	Meteorologische Beobachtungen angestellt in Dorpat im Jahre 1877 and Jahren 1878, 1879, 1880.
EDINBURGH . . .	Scottish Meteorological Society . .	Journal, 3rd series, No. 1.
GOA . . .	Royal Observatory . . .	Observacoes Meteorologicas de Goa 2nd semestre do Anno de 1881.
GREENWICH . . .	Royal Observatory . . .	Greenwich magnetical and meteorological observations for 1882.
	Deutsche Meteorologische Gessellschaft.	Meteorologische Zeitschrift, January 1884 to January 1885.
	Deutsche Seewarte . . .	Wetterbericht, Vol. IX, Nos. 61 to 336; Vol. X, Nos. 1 to 59. Monatliche Ubersicht der Witterung; September to December 1883 and Jahre, January to June 1884.
HAMBURGH . . .		Archiv der Deutschen Seewarte Jahr. IV, 1881.
		Meteorologische Beobachtungen in Deutschland 1879 to 1880.
	Dr. A. Von Danckelman . . .	Mémoire sur les observations Météorologiques faites a Vivi (Congo Inferieur) et sur la climatologie de la côte sudouest d'Afrique en Général.
	Dr. W. Köppen	Bericht über die Verwaltung der meteorologischen Abtheilung der Regierung von Indien im Jahre 1882-83.
HAVANNA . . .	Real Collegio de Belen . . .	Observaciones Magneticas y Meteorológicas, Año 1875.
		Weather Report, January to July 1884.
		Report on the Organization of the Meteorological Service in China; and Instructions for making Meteorological Observations, prepared for use in China.
		Report on some Magnetical Observations made in October and November 1883.
HONGKONG . . .	Government Astronomer . . .	Report on the Mean Direction and Force of the Wind at Victoria Peak, Hongkong.
		Report on the Mean Cloudiness of Hongkong.
		Report on the Mean Monthly and Annual Rainfall at Hongkong.
		Notices about Storm Signals in the China Sea.
		Report of the Government Astronomer for 1884.
		Instructions for making Meteorological Observations, prepared for use in China.
JEYPORE . . .	Superintendent of Raj Dispensaries	Annual Report of the Jeypore Medical Institutions for 1883.
KEW . . .	G. M. Whipple	Preliminary enquiry into the causes of the variations in the readings of the black bulb thermometer in vacuo.
	Kew Committee of the Royal Society.	Report of the Kew Committee for the year ending 31st October 1884.
LAHORE . . .	Meteorological Office . . .	Annual Report on the Meteorology of the Punjab for the year 1883-84.
	G. J. Symons, Esq.	Symons's Monthly Meteorological Magazine, March 1884 to January 1885.
	Hon'ble Ralph Abercromby, F.R.M.S.	The Explanation of certain Weather Prognostics.
		The Reduction of Wind Records.
		Weekly Weather Report, title page for Volume IV (1883).
		" " " new series, Vol. I, Nos. 1 to 43.
LONDON . . .		Daily Weather Reports, 1st July 1883 to 30th June 1884.
		The Monthly Weather Report, January to October 1884.
	Meteorological Office . . .	A Barometer Manual for the use of Seamen.
		Report of the Meteorological Council to the Royal Society for the year ending 31st March 1883.
		Quarterly Weather Report, new series, parts III and IV, 1876; Appendices and Plates, 1878.
		Hourly Readings, 1882, parts II and III.

Presentations to the Library from the 1st April 1884 to the 31st March 1885—continued.

Place.	Donors.	Title of Work.
LONDON— <i>contd.</i>	Meteorological Office . . .	Charts showing the surface temperature of the Atlantic, Indian, and Pacific Oceans.
	R. H. Scott, F.R.S. . . .	Note on a series of barometrical disturbances which passed over Europe between the 27th and the 31st of August 1883.
	R. H. Scott, F.R.S. . . .	Report from H. B. M.'s Consul at Batavia, enclosing extract relating to the volcanic outbursts in the Sunda Straits from the Logbook of S.S. "Governor General, London."
	Royal Asiatic Society . . .	The Equinoctial Gales: Do they occur in the British Isles.
	Royal Asiatic Society . . .	Journal, Volume XVI.
	Royal Meteorological Society	Charter and Bye-laws of the Royal Meteorological Society.
	Royal Meteorological Society	The Meteorological Record, Nos. 11 to 14.
	Royal Meteorological Society	List of Fellows of the Royal Meteorological Society, 1st March 1884.
	Royal Meteorological Society	Quarterly Journal, new series, Vol. X, Nos. 49 to 52.
	Royal Society . . .	Proceedings, Vol. XXXV, No. 227; Vol. XXXVI, Nos. 228 to 231; Vol. XXXVII, No. 232.
MADRAS . . .	Society of Arts . . .	Journal, Nos. 1634 to 1685.
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	Government Astronomer . . .	Meteorological observations made at the Hon'ble East India Company's Magnetical Observatory at Singapore in 1841 to 1845.
	Government of Madras . . .	Annual Administration Reports of the Forest Department (Southern and Northern Circles) Madras Presidency, for the year 1882-83.
MAGDEBURGH . . .	Government of Madras . . .	Report on the measurement of rates of growth of Casuarina in the Nellore District.
	Magdeburghischen Zeitung . . .	Jahrbuch der meteorologischen Beobachtungen, Jahrg II, 1883.
MANCHESTER . . .	Literary and Philosophical Society	Proceedings, Vols. XX to XXII.
	Literary and Philosophical Society	Memoirs, 3rd series, Vols. VII and IX.
MELBOURNE . . .	Meteorological Observatory . . .	Monthly Record of Results of Observations in Meteorology, Terrestrial Magnetism, &c., taken at the Melbourne Observatory from December 1883 to September 1884.
MEXICO . . .	Central Meteorological Observatory.	Boletin del ministerio de Fomento de la Republicana Mexicana, Tomo IX, Nos. 1 to 64.
	Central Meteorological Observatory.	Magnetical Observations, January to March 1884.
MILAN . . .	R. Osservatorio Astronomico di Brera.	Osservazioni meteorologici eseguite negli anni 1875 e 1883.
	R. Osservatorio Astronomico di Brera.	Sulle variazioni diurne del magnetismo terrestre risultati di osservazioni fatte a milano negli anni 1872 e 1877.
	R. Osservatorio Astronomico di Brera.	Teoria degli stromenti ottici con applicazioni ai telescopi ed alla fotografia celeste.
MUNICH . . .	Geographical Society . . .	Jahresbericht der Geographischen Gesellschaft in München für 1882 und 1883.
	Publishers . . .	Deutsche Rundschau für Geographie und Statistik, Vol. IV, No. 2; Vol. VI, Nos. 7 to 12.
	Publishers . . .	Sitzungsberichte der mathematisch-physicalischen Classe, 1883, Heft III; 1884, Heft I.
	Royal Academy of Sciences . . .	Abhandlungen, Vol. XV, part I.
NAGPUR . . .	Royal Academy of Sciences . . .	Franz von Kobell. Eine Denkschrift.
	Royal Academy of Sciences . . .	Gedächtnissrede auf Theodor L. W. von Bischoff.
	Royal Academy of Sciences . . .	Sugar cultivation in the Central Provinces.
	Royal Academy of Sciences . . .	Report on the Nagpur experimental farm in the Central Provinces for the year 1883-84.
NAGPUR . . .	Chief Commissioner, Central Provinces.	Report on the Trade and Resources of the Central Provinces for 1883-84.
	Chief Commissioner, Central Provinces.	Report on the Road side arboriculture in the Central Provinces for the year ending 31st March 1884.

Presentations to the Library from the 1st April 1884 to the 31st March 1885—continued.

Place.	Donor.	Title of Work.
NAGPUR— <i>contd.</i>	Chief Commissioner, Central Provinces.	Returns of Rail-borne Traffic during the quarters ending 30th June and 30th September 1884. Third Wheat Forecast of the Central Provinces.
NEW HAVEN . . .	Connecticut Academy of Arts and Sciences.	Transactions of the Connecticut Academy of Arts and Sciences, Vol. VI, part 1.
NEW YORK . . .	Meteorological Observatory.	Abstract of registers from self-recording instruments, December 1883 to November 1884.
OXFORD . . .	Radcliffe Observatory . . .	Results of the meteorological observations made at the Radcliffe Observatory, Oxford, in the year 1881.
	Academy of Sciences . . .	Mission Scientifique du cap Horn 1882-83, Rapports préliminaires.
PARIS . . .	Bureau Central Météorologique de France.	Bulletin International, Vol. XXXVIII, Nos. 53 to 360, Vol. XXXIX, Nos. 1-57. Annales du Bureau Central Météorologique de France Année 1881, parts I, III and IV.
	Météorological Society of France . . .	Annuaire, November 1883 to March 1884.
PERTH (WESTERN AUSTRALIA).	Surveyor General . . .	Western Australia Meteorological Report for 1882.
PESARO . . .	Meteorological and Magnetical Observatory.	Curves, April 1879 to December 1880.
PHILADELPHIA . . .	Franklin Institute . . .	Journal, February 1883 and March 1884 to February 1885.
PRAGUE . . .	Imperial Observatory . . .	Astronomische, magnetische und meteorologische Beobachtungen an der K. K. Sternwarte zu Prag in Jahre 1883.
RIO DE JANEIRO . . .	Imperial Observatory . . .	Bulletin Astronomique et météorologique, September 1881 to November 1883. Annales, Tomo II.
SANTIAGO . . .	Observatoire Nacional . . .	Observaciones Meteorologicas, 1873 to 1881.
SIMLA . . .	Inspector-General of Forests with the Government of India.	Review of the Forest Administration in British India for 1882-83.
SINGAPORE . . .	Colonial Surgeon, Straits Settlements.	Straits Settlements Meteorological Returns, 1883.
STONYHURST . . .	Reverend S. J. Perry, F.R.S.	Results of meteorological and magnetical observations recorded at the Stonyhurst College Observatory during 1883.
ST. PETERSBURGH	Physical Central Observatory	Annalen des Physicalischen Central Observatoriums; Jahrg 1882.
	International Polar Commission	Repertorium für Meteorologie, Band VIII. Communications from the International Polar Commission, parts 5 and 6.
SYDNEY . . .	Observatory . . .	New Double Stars, H. C. Russell. Results of Rain and River Observations made in New South Wales during 1883.
SYRACUSE . . .	Osservatorio Centrale di Siracusa . . .	Physical Geography and Climate of New South Wales. Osservazioni meteorologiche, July 1882 and January to May 1884.
TASMANIA . . .	Royal Society of Tasmania . . .	Report of the Royal Society of Tasmania for the year 1883. Papers and Proceedings of the Royal Society of Tasmania for 1883.
TOKIO . . .	Imperial Meteorological Observatory.	Meteorological observations recorded at Wakayama, August to December 1882, and at Aomori, Hiroshima, Kioto, Kanasawa, Kochi, Nagasaki, Niigata, Nobiru, Osaka, Tokio and at Wakayama, during the year 1882.
	University . . .	Monthly summary (March to December) and monthly means for the year 1883 with 37 maps. Measurement of the force of gravity.
TORONTO . . .	Meteorological Office . . .	Monthly Weather Review, February to December 1884. General Meteorological Register for 1884. Report of the Meteorological Service of the Dominion of Canada for 1882.

Presentations to the Library from the 1st April 1884 to the 31st March 1885—concluded.

Place.	Donors.	Title of Work.
TURIN	Observatory	Bolletino dell' osservatorio della regia universita di Torino, 1883.
		Effemeride del sole, della Luna e dei principali Pianeti calcolati per Torino in tempo medio civile di Roma per l'anno, 1884 and 1885.
		Nuovo Materiale Scientifico e prime osservazioni con Anelli micrometrici all' osservatorio di Torino.
UPSALA	Observatoire Météorologique de l' université.	Prime Osservazioni con Anelli micrometrici all' osservatorio di Torino.
		Bulletin mensuel, Vol. XV, Année 1883.
VIENNA	Dr. J. Hann	Zeitschrift der oesterr Meteor. Gesellschaft, Band XIX, April to December 1884; Band XX January and February 1885.
	Dr. J. M. Pernter	Beitrag zu den Windverhältnissen in höheren Luftschichten.
	K. K. Central-Anstalt für Meteorologie und Erdmagnetismus.	Internationaler telegraphischer Wetterbericht, Vol. VIII, Nos. 42 to 366, Vol. IX, Nos. 1 to 41.
		Jahrbucher Neue Folge, Band XVII, Jahrg 1880; Band XVIII, Jahrg 1881; Band XIX, Jahrg 1882, Erster Theil.
		Anleitung zur Ausführung meteorologischer Beobachtungen an stationen II und III Ordnung.
VIZAGAPATAM	K. K. Geologischen Reichsanstalt .	Jelineks Anleitung zur Ausführung meteorologischen Beobachtungen nebst einer Sammlung von Hilfstafeln.
		Verhandlungen, Nos. 1 to 18 of 1884; Nos. 1 and 2 of 1885.
WASHINGTON	A. V. Nursingrow, Esq., F.R.A.S., F.R.G.S.	Results of Meteorological Observations taken at the G. V. Juggarow's Observatory, Vizagapatam, during 1883.
	Chief Signal Office	International meteorological observations, 1st January 1882 to 30th June 1883.
		Bulletin of International Meteorology, Summary, January to December 1883.
		Monthly Weather Review, February 1883 to December 1884.
		Memoranda on International Scientific Co-operation in Meteorology, Magnetism, &c.
		The use of the Spectroscope in Meteorological Observations.
	Report of the Chief Signal Officer, U. S. A. War Department, for 1879 to 1882.	
	Professional papers of the Chief Signal Office, Nos. VIII to XII and XIV.	
	Philosophical Society	Bulletin of the Philosophical Society of Washington, Vols. IV to VI.
	Professor E. Loomis	Contributions to Meteorology, 20th paper. Reduction of barometric observations to sea-level.
Smithsonian Institution.	Smithsonian Report for 1881 and 1882.	
WELLINGTON (NEW ZEALAND.)	United States Geological Survey .	Second Annual Report of the United States Geological Survey for 1880-81.
	United States Naval Observatory	Meteorological observations made at the United States Naval Observatory during the year 1880.
		Report of the Superintendent of the United States Naval Observatory for the year ending 31st October 1884.
	W. Upton	Report of observations made on the expedition to Caroline Island to observe the total solar eclipse of 6th May 1883.
	Meteorological Office	Abstract of Meteorological Observations, New Zealand, for the quarters ending 31st December 1883, 31st March and 31st June 1884.
Statistics of New Zealand, 1883 (Meteorology).		
Meteorological Report, 1883, including returns for 1880, 1881, 1882 and averages for previous years.		
ZI-KA-WEI	Magnetical and Meteorological Observatory.	Bulletin Mensuel, July 1883 to March 1884, and year 1883.
		Les typhoons des mois de Juillet et Août 1882.
		The typhoons of 1882.
ZURICH	Swiss Meteorological Institute .	Schweizerische Meteorologische Beobachtungen, 1880 to 1882 and 1884.

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- American Journal of Science, March 1884 to February 1885.
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 L'institut Météorologique Danois et le Deutsche Seewarte, 1er trimestre, December 1880 to February 1881, 2nd
 trimestri, March to May 1881; 3me trimestre, Juin to, Aout 1881.
 Comptes Rendus de l'Académie des Sciences, Tome XCVIII, Nos. 9 to 26; Tome XCIX; Tome C, Nos. 1 to 8; and
 Tables for Tomes XCVII and XCVIII.
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 Dictionary of Chemistry, Vols. I to VIII.
 Electricity and Magnetism—Jenkin.
 Encyclopædia Britannica, Vols. XVI and XVII.
 Handbuch der Klimatologie—Hann.
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 Instructions for testing lines, batteries and instruments, and guide to the technical arrangement of Telegraph Offices in
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 Joule's Scientific papers, Volume I.
 La Nature, Nos. 563 to 614.
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 Nature of Light—G. G. Stokes.
 Papers on Electrostatics and Magnetism—Sir W. Thomson.
 Philosophical Magazine, March 1884 to February 1885.
 Repertorium der Deutschen meteorologie—Hellman.
 Report of the British Association for the Advancement of Science for 1883.
 Roorkee Hydraulic Experiments, Volumes I to III.
 Sound—Tyndall.
 Text Book on the Principles of Physics—A. Daniel.

REPORT

ON

THE ADMINISTRATION

OF THE

METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA

IN

1885-86.

PART I.—GENERAL.

IN accordance with the practice of recent years, I preface the report on the detailed administration of the department, with a notice of some of the more important subjects to which attention has been directed during the past year.

ACTINOMETRIC OBSERVATIONS.—In the reports for three previous years, I have recounted the history of my endeavours to obtain more exact measures of the solar heat than had been practicable in the atmosphere of either Europe or India. With that object, Sergeant Rowland, who had been selected and sent out by the Secretary of State in 1882, after undergoing a thorough training at Dehra under the direction of Mr. J. B. N. Hennessey, was despatched to Leh in October 1883, together with a trained assistant. In last year's report, I had to relate how, owing to the adverse conditions of the climate, the results had fallen far short of our hopes and expectations, and I gave a tabular return of these results, amounting up to the end of March 1885, to 52 complete and 64 incomplete ordinary daily series of observations, and 6 complete and 14 incomplete long series.

The observers remained at Leh, continuing their work until the beginning of October 1885, and during the further interval of six months, obtained the following additions to their previous registers :—

MONTHS.								Daily complete.	Series incomplete.	Long complete.	Series incomplete.
April 1885	.	.	.	.	.	.	.	...	2	...	...
May	"	.	.	.	.	.	.	...	1	...	...
June	"	.	.	.	.	.	.	3	5	...	1
July	"	.	.	.	.	.	.	5	9	1	...
August	"	.	.	.	.	.	.	...	9	...	...
September 1885	.	.	.	.	.	.	.	...	5	...	...
Total of six months								8	31	1	1
" previous 17 months								52	64	6	14
" whole period								60	95	7	15

The complete series of the final six months fell therefore considerably short even of the previous average, and it would obviously have been useless to prolong the experience. Sergeant Rowland and his assistant were therefore instructed to withdraw from Leh, at the end of the season, in time to ensure their reaching India before the closing of the passes. They left accordingly on the 3rd October and reported their arrival at Dehra on the 9th November, bringing back their instrumental equipment, which was then made over to the charge of Colonel Haig, Deputy Surveyor General in charge of the Dehra Office.

The instruments were in excellent order, and will be available for future work. Under the sanction of the Government, the services of Sergeant Rowland have been transferred to the Survey Department to carry on the work of solar photography, with the large heliographs provided for this purpose at Dehra. The assistant, Mr. H. Shaw, has been since employed carrying on the actinometric observations at Dehra and Mussooree, also under the direction of Colonel Haig. It is probable, judging from Mr. Hennessey's former experience, that, notwithstanding the lower elevation of this station and Mussooree, they will be found at least as well fitted for the work as Leh, while they offer far superior advantages in point of climate and accessibility.

The results of the 23 months' work at Leh have been sent home to the Solar Physics Committee for examination and discussion, copies being retained in this country. It may be hoped that, notwithstanding that they fall far short of what had been expected, they may still be found to yield information of much value. I have every reason to believe that they have been taken with the greatest care and attention to accuracy, in accordance with the elaborate system devised by Mr. Hennessey, and that all has been accomplished that could be accomplished by careful training, and assiduous devotion to the work on the part of the observers. Of their conduct during their two years' residence in Leh, I cannot give a better idea than to quote from the certificates forwarded by Sir Oliver St. John, Her Majesty's Resident in Kashmir, with the request that their excellent conduct may be brought to the notice of the Government of India. The Wazir of Ladak, Radha Kishen, writes to Sir O. St. John: "During two years of their stay here, for the greatest part of which their immediate superior, the British Joint Commissioner, was away, they always conducted themselves to my entire satisfaction They leave this country with my best wishes, and I hope that their good conduct and hard work in such a severe country as Ladak, where they have spent two winters continuously, will be the means of their advancement in their future employment." And Mr. Ney Elias, the British Joint Commissioner, observes: "I cannot leave this Agency without recording my good opinion of Sergeant Rowland For several months, during the absence of the Political Agent, he has carried on the current duties of the Agency Office. The way in which he has conducted himself throughout has been most creditable He has done his own duty, has got on well with the native officials and people of the country, and might be trusted to act with judgment and good sense in any independent position in a foreign country I hope his good services and admirable conduct will be duly recognised by the authorities at home."

SUNSHINE RECORDS.—During the past year, instruments for recording the duration of sunshine have been furnished to Lahore and Nagpur, making, with those already provided with them in previous years, five stations at which this important meteorological

element is now the subject of regular registration. The other stations are Calcutta, Allahabad and Jeypore, where these records are now available for the following periods :—

Allahabad	.	.	.	.	since April 1882.
Calcutta	.	.	.	.	„ January 1883.
Jeypore	.	.	.	.	„ February 1884.

I offered in March last to supply an instrument to the Colaba Observatory, Bombay, but it has been declined by the Superintendent. It has therefore been sent to the Meteorological Reporter for Western India, whose office is situated at the Observatory, with instructions to obtain a regular register by its means.

GROUND TEMPERATURE.—A set of thermometers for registering the temperature of the ground, at the surface and at different depths of a few feet, (within the zone subject to an annual oscillation of temperature) has been furnished during the past year to Lahore. Observations of this kind have now been recorded under a similar arrangement for some years at Calcutta, Allahabad, Dehra and Jeypore, *viz.* :—

Calcutta (Alipore)	.	.	.	.	since April 1878.
Allahabad	.	.	.	.	„ May 1880.
Dehra	.	.	.	.	„ June 1881.
Jeypore	.	.	.	.	„ August 1881.
Lahore	.	.	.	.	„ August 1885.

These registers testify uniformly to the fact that, the ground is on an average from 3 to 5 degrees warmer than the air; the difference varying, however, with the time of year and also with the depth. It varies moreover, in some small degree, from year to year according, as would appear, to the relative prevalence of sunshine and rain. It appears that the ground acts as a store-house of solar heat, which penetrates to a depth the limits of which are not yet ascertained in India, and is gradually given out again to the superincumbent air. At Calcutta, the registers have established the important fact that, the temperature of the alluvial soil increases rapidly downwards, (at the rate of about 1° in 2 feet for the first few feet) indicating the existence of a permanent source of heat within a short distance of the surface. This source is probably to be found in a layer or layers of decomposing organic matter, sometimes reached in deep excavations for tanks, &c.

As the result of a long series of observations on the temperature of the rock of Calton Hill, Edinburgh, it has been thought probable that the variations of the ground temperature, from year to year, would serve as an indication of those of the solar heat. This, however, seems very doubtful. It is evident that the ground temperature is largely modified by rain and its subsequent evaporation, and it is unlikely that a much smaller temperature variation, arising from the assumed variability of the solar radiation, would be discoverable in the registers of any moderate period.

FIRST CLASS OBSERVATORIES.—There have been hitherto only three observatories in India, fully equipped with autographic instruments, for furnishing either a continuous register, or one repeated at short (ten minutes') intervals. These were the Government observatories at Calcutta (Alipore) and Bombay, and the Maharajah's observatory at Jeypore. During the past year, a fourth has been established at Allahabad, and a portion of the instruments for a fifth at Lahore, were received shortly after the close of the year, a suitable building having been already provided.

The new Allahabad Observatory is situated in the large open space known as the Chatham lines—a site admirably fitted for the purpose. The building has been erected for

the accommodation of the observatory and the Meteorological Reporter's Office at an estimated cost of **₹13,000** and is therefore especially adapted to the proper exposure and working of the instruments. The autographic instruments consist of a Van Rysselberghe's meteorograph (the duplicate of that at Jeypore). It is worked by clock-work and electricity, and records at intervals of 10 minutes, the readings of the barometer, the wet and dry bulb thermometers, the duration of the wind, and also the distance travelled by the wind and the amount of rain that may have fallen in the previous ten minutes. All these are engraved on a zinc plate, graduated by the instrument while in the act of recording the reading, which, after removal from the instrument, is etched, and may then be printed from, and made to furnish any required number of copies of the register.

The instrument was set up and began to work in the beginning of March 1886. It will take some little time to accustom the observatory staff to the management of this new, somewhat complex and delicate instrument, and hitherto there have been occasional interruptions in its working. With increased experience and under Mr. Hill's guidance, it may be confidently expected that all difficulties will be eventually surmounted.

The similar meteorograph which was originally intended for the Lahore Observatory, having been disposed of to the Maharajah of Jeypore, it has not been thought desirable to obtain another for Lahore, where the difficulty of adjusting and managing it would have been much greater. And therefore a set of self-recording instruments will be supplied, which are simple in principle, independent in their action, and which register mechanically. Those for recording the atmospheric pressure, temperature and humidity, are the invention of Dr. Draper, and are similar to those which have long been in use in the New York Observatory. Those for rainfall and wind registration are the invention of Mr. Beckley and similar to those used at Kew and also at the Alipore Observatory in Calcutta. These latter are already in India.

The removal of the Lahore Observatory from the Mayo Hospital to a building nearly 4 miles distant, on the outskirts of Anarkalli, at the beginning of 1885, necessitated that observations should be recorded simultaneously at the old and new sites, sufficiently long to show what change in the apparent normal or average temperature, humidity, &c., of Lahore has been caused by the removal. These observations were carried on during 1885, and will be continued up to the end of 1886. There will then be two entire years' registers available for comparison, and these should suffice to show what corrections must be applied to the registers of past years to render them comparable with those of the present and future years.

RAINFALL STATISTICS.—Some further additions of importance have been made, during the past year, to the stations transmitting regular returns of the rainfall to the Central Office.

Most of these are due to the extension of rainfall registration in Rajputana, through the exertions of Dr. Hendley, Residency Surgeon at Jeypore; and some are of especial value, as representing the arid region of Western Rajputana, which, but a few years since, was an almost complete blank on the charts of recorded rainfall. The following are the newly-established stations:—

Bandikui.	Jhunjhnu.
Lalsot.	Sri Madhopur.
Siwai Madhopur.	Sikar.
Malpura.	Khetri.

Another important addition is that of Kelat in Beluchistan, and a third that of Pedong in Bhotan.

Including observatories, rainfall registers are now received from 484 stations in India and its dependencies, including Ceylon and other islands.

SNOWFALL REPORTS.—Reports of the snowfall on the mountains of the north-western and northern frontiers were received during the spring of 1885 from the following officers :—

The Deputy Commissioner of Bannu.	The Assistant Commissioner of Kulu.
" " " Dera Ismail Khan.	" Revd. A. W. Heyde, Kailang, Lahoul.
" " " Kohat.	" Collector of Kumaon.
" Political Agent, Khyber.	" Assistant Commissioner of Garhwal.
" Assistant Commissioner of Eusufzye.	" Civil Surgeon of Mussooree.
" Deputy Commissioner of Peshawar.	" Deputy Commissioner of Darjeeling.
" " " Rawalpindi.	" " " Kamrup.
" " " Kangra.	" " " Darang.

In many of the reports there was a considerable improvement on those of the preceding year, and those of the Deputy Commissioner of Kohat, the Assistant Commissioner of Kulu, and one or two others gave much useful information, collected from travellers and traders, as to the depth of snow on the passes and hills beyond the frontier. The Reverend A. W. Heyde's reports are also especially valuable as those of an intelligent observer, resident for many years in the inner Himalaya.

During the present cold weather and spring, reports have been received regularly from the same officers.

FORECAST OF THE MONSOON.—An attempt to estimate the prospects of the monsoon rains, based on the results of the snowfall reports and the general character of the winds and pressure distribution in the period immediately antecedent to the rainy season, has been made in each of the last two or three years. In 1885, the indications on which this forecast was based, were of a more pronounced character than in either of the previous years, and the prediction which they seemed to justify, *viz.*, that the influx of the monsoon rains, on the west coast and in Southern and Western India generally, would be retarded, was so amply borne out by the subsequent history of the season, that my confidence in the general validity of the method has been very much strengthened.

In a memorandum, dated 21st May, it was reported that "the snowfall on the Himalaya appears to have been universally heavy during the past season, and it has received continual additions up to the present time;" that "the unusual weather of April and May had made large additions to the snows of the North-West Himalaya, preserving thick snow-beds down to 11,000 feet, even on the outermost hills, and mantling the higher ranges with an unbroken sheet of snow." From Kailang in Lahoul, the Reverend A. W. Heyde had written on the 4th May: "This is a very extraordinary spring, cold and exceedingly wet for Lahoul. On the northern slopes the fields are still covered with about 1½ feet of snow at this moment, which is altogether unusual for this part of Lahoul," &c. It was pointed out that the weather in the Punjab and, in a minor degree, all over Western India, had been unusually cool, and the barometer persistently high; that "owing to the coolness, the excess of pressure has been much greater on the plains than on the mountains; and greater in North-Western India, than to the east and south;" "more or less, the

pressure has been above the average all over India, and although subject to marked oscillations, the average remains unusually high."

"Under such circumstances as these, west and north-west winds are always very prevalent in North-Western and Western India, and this has been the case during the present month (May). In some years they are most persistent in Northern India, blowing down the Gangetic plain and across Rajputana and Central India towards Bengal and Orissa. In other years they blow more steadily down the western side of the peninsula, in the Konkan and Western Deccan. The latter appears to be the case in the present year. . . . Coming from a cool region, where there is little evaporation, these winds are always dry, and in proportion as they prevail, to the exclusion of the ordinary monsoon from equatorial seas, so is the season dry or wet Any condition that unduly raises the barometric pressure in North-Western India and on the Himalayas, and in Afghanistan and Beluchistan, favours the north-west winds. And since rain on the plains and unusual snow on the hills keep the air cool and heavy, they afford such a condition. But, if this depends on the extent of the Himalayan snows alone, it is not very lasting, although it may operate for some weeks."

Having thus traced out the grounds and principles on which the forecast was based, the conclusion was put forward in the following terms:—

"At present it would appear that the influx of the monsoon rains, on the west coast and in Southern and Western India generally, is likely to be retarded, and it is this branch of the monsoon that brings the greater part of the rainfall to the peninsula, Central and Western India. But in 1876, 1877 and the earlier part of 1878, the barometer was high over a large part of Asia, owing to some cause or causes as yet unknown; and this undoubtedly was one cause of the severe droughts of those years As far as our information goes, there is no reason for anticipating more than a retardation of the rains of the west coast."

"If the conditions remain as at present, there is no reason to anticipate any retardation of the monsoon on the Bengal side as well, but the only ground, at present, for forming a judgment on this point, is that there is a certain persistency in the weather phases of India; and that as the north-west winds seem at present to hold down the west of the peninsula, rather than across Northern India, there is a balance of probability in favour of their remaining so."

How far this forecast was realized, will best be shown by the following extracts from the monthly summaries of the weather, based on the telegraphic reports, and the preliminary report on the meteorology of the year, drawn up by Mr. Dallas, from the tabulated results of all the meteorological stations.

In the weather summary for June it is stated that the rainfall "has been distinguished by two noticeable characteristics: in the first place, the fall has been accompanied by a very unsteady monsoon current, while in the second place the extent of the fall has been greatly restricted. In Bombay itself, the burst of rain which usually characterizes the setting in of the monsoon on the Konkan coast has not occurred during the month, and the winds over that region appear to have been abnormally dry; and further to the southward, *i.e.*, on the Malabar coast, though the winds appear to have brought up the normal amount of moisture, it seems to have been deposited only on the western face of the Ghâts, and the stations on the Deccan and Hyderabad show a great deficiency of rainfall. The

weather in the Berars, Khandesh and Guzerat has been similar to that prevailing in the Konkan, the winds having been unusually dry."

In Bengal¹ "on the 16th, a small depression was formed over the Sunderbuns; and as this little disturbance travelled, first westward and subsequently north-westward, the rains extended up the Gangetic plain, and by the 24th has set in over the greater part of the North-West Provinces. On the 26th, a second depression was formed over the Sunderbuns, and this disturbance travelling westward in its turn, fairly established the rains over the North-Western Provinces and as far west as Delhi and the east of the Punjab."

In the report for July it is stated "heavy rain fell at Mangalore on the 1st. This proved to be the beginning of a burst of rather heavy rain on the west coast, lasting until the 9th and spreading northward as far as Ratnagiri, without however reaching Bombay." . . . On the 17th, a fall of six inches occurred at Bombay, and larger amounts on the neighbouring hills. This was the first downpour of the season on the Konkan coast, and resulted in extensive floods in the neighbourhood of Bombay In the eastern and central parts of the peninsula, the normal westerly winds appear to have been exceptionally dry; and Mysore, Bellary and the Carnatic had even less than the small average rainfall. Further north, in the Northern Circars, Orissa, Chutia Nagpur and Lower Bengal, there has been a slight deficiency; but in Assam, Cachar, Northern Bengal and over the whole of the North-Western Provinces and Oudh, the rainfall has been excessive The figures for the season, up to date, show that the rains have been unfavourable in two regions—one includes the Konkan, Khandesh, and the Bombay Deccan, where the amount of rainfall for the two months, June and July, has been only from $\frac{1}{5}$ to $\frac{1}{2}$ the average amount, and the other the Punjab. In all other parts of the country the seasonal average has been fairly well maintained.

In August "during the first ten days the rainfall on the west coast was insignificant; but on the 12th it became heavier, . . . and during the week following, heavy showers fell at the majority of the peninsular stations." In the region under the influence of the Bengal branch of the monsoon, the weather was practically the same as in the preceding month.

From these reports, the general tenor of which is fully borne out by the more abundant data since received, it appears that the terms of the forecast made on the 21st May were very amply justified by the results.

TRUE CHARACTER OF THE MONSOONS.—Any successful attempt to forecast the prospects of the monsoon, or even to give a rational explanation of the variations which it has manifested, must be based on a true conception of its normal characters and its real nature. The description of the summer monsoon, which appears in most treatises on the subject, and which therefore represents the ideas most prevalent among well-informed persons, may be summarized somewhat as follows:—

The summer monsoon is regarded as an anomalous diversion of the south-east trade wind of the South Indian Ocean. Owing to the high temperature developed in the continent of Asia in the early summer months, and the consequent lowering of the atmospheric pressure, instead of a trade wind setting from the northern tropic towards the equator,

¹ The average date for the setting in of the rains in Bengal is the 15th June. At Bombay it is usually estimated a few days earlier.

as is the case in the Atlantic and Pacific Oceans, the south-eastern trade of the South Indian Ocean is prolonged across the equator and drawn onwards to Southern Asia as the south-west monsoon. This wind is saturated with vapour taken up from the expanse of sea over which it has passed, and the vapour is discharged as rain on India, the Malay Peninsula and China, in the rainfall of the summer monsoon.

This view, while true as a first rough sketch of the facts, is in a certain measure erroneous; firstly, as an over-statement of fact, and secondly, regarded from another point of view, it is defective, inasmuch as it leaves unexplained the existence of a rainless or almost rainless region in Western India, and on the coast of Beluchistan; and also it affords no means of accounting for such vicissitudes of the monsoon rainfall as characterized the past year, and in a far more intense degree the year 1876.

In the first place, it is an over-statement of fact. The wind charts of the North Indian Ocean, now in course of preparation, show that the south-east trade, does not, as a rule, blow across the equator, and, changing its course from south-east to south and finally to south-west, pass gradually into a south-west monsoon. That it does occasionally do so is unquestionable, but such is rather the exception than the rule. A rainy belt in the neighbourhood of the equator exists throughout the year, which is fed by the south-east trades. In this belt, the winds are very variable, blowing from all quarters, from west-north-west round to south; and it is only some 6° to the north of the equator that the monsoon is established as a comparatively steady current of wind. The monsoon therefore, (in so far as it is a *south-west* monsoon,) is drawn from a reservoir of air over the equatorial zone, fed by the south-east trades, but it is not the south-east trade wind simply diverted from its former course. And the distinction is an important one.

Moreover, the Indian summer monsoon is not simply a *south-west* monsoon; and herein the prevalent view is defective in an important particular. On the Arabian Sea, and especially beyond the tropic, the winds are as frequently west as south-west and not infrequently north-west, and this is also the case on the west coast of India. The less southerly or the more northerly the wind, the finer is the weather, and the smaller the rainfall of the Bombay Presidency. The explanation of these facts is that, at certain times, a considerable portion of the air which enters into the western branch of the monsoon is not drawn from equatorial regions at all, but from the dry coasts or still drier plains and mountains to the north. In all years, in the summer season, this dry air furnishes the greater part of the winds of the Lower Indus Valley and Western Rajputana, and hence the rainlessness of this portion of Western India. And according to the variation of atmospheric pressure over the continent of Asia, so does it enter in larger or smaller proportion into the wind current which sweeps the northern half of the Arabian Sea, and carries drought, either temporary or prolonged, to Guzerat, Khandesh or the Deccan.

These corrections of the prevalent conception of the character of the summer monsoon have therefore a practical bearing of very considerable importance. The next step towards an explanation of the causes of drought and famine will be to ascertain, if possible, what circumstances favour and what are adverse to the extended prevalence of the dry northerly element of the monsoon. These have been briefly alluded to in the forecast of the monsoon of 1885, quoted on a preceding page; there are now very good grounds for believing that an unusual extent of snow on the mountain tract of Beluchistan, Afghanis-

tan and the North-Western Himalaya favours the dry northerly element of the monsoon. But there are also grounds for believing that this cause and therefore its effects are not very lasting, and that great droughts, such as those of 1876 and 1877, depend on atmospheric conditions of much wider prevalence.

INFLUENCE OF FORESTS ON CLIMATE.—*Forest Observatories.*—Some time before Dr. Brandis's retirement from the office of Inspector General of Forests with the Government of India, he consulted me on the establishment of observatories in connection with the forests, with a view to ascertaining the effect of forests, more especially on temperature and rainfall. Observations of this kind have been made somewhat extensively in Europe, and the work of Ebermeyer¹ on the results of five years' systematic observations, at comparative observatories (within and without the forests) in Bavaria, is a well-known standard treatise on the subject.

As the result of this consultation, the first step taken in the Forest Department was to establish an observatory at the Forest School at Dehra-Dun, which should serve as a model for the forest observatories and a training school for observers. Arrangements were made, by Dr. Warth, for recording temperature, the humidity of the air and the rainfall near the ground and also 66 feet above it, and these observations have been carried on regularly, from October 1882 up to the present time.

In July 1884, the first pair of comparative observatories was started at the Forest Nursery, Ajmere; they were less complete in plan than the Dehra model, sheds of similar pattern being erected under the trees of the forest and in the open ground outside the forest; and readings of the maximum, minimum and 10h. and 16h. temperatures were recorded with thermometers therein exposed, the instruments having been previously verified at the Alipore Observatory. In this case, rainfall was recorded only outside the forest.

In August 1885, another pair of observatories, similarly furnished, was established at the Mohwa Bir Forest, Ajmere, and from the beginning of the present year (1886) comparative measurements of rainfall have been made both within and without six forests in the Ajmere-Merwara reserves.

In June 1884, comparative observatories were established in the Dun at the Ramgarh forest, and in March 1885, a similar pair in the Rajah's forest, by Mr. Fisher, the Director of the Forest School. These are on the same plan as the model observatory at the Dehra Forest School; observations of temperature, humidity and rainfall being recorded both near the level of the ground and also at an elevation of 60 feet above it, on a structure originally designed and constructed by Dr. Warth.

The results of these observations, so far, seem to show slightly but appreciably higher rainfall in the forest than without. Before, however, this can be accepted as a valid generalization, unquestionably a careful enquiry must be made into the possible existence of other circumstances affecting the contents of the rain-gauge, besides that obvious difference of position, the effects of which is the aim and object of the observations to gauge;² but it is certainly noteworthy that the large majority of the comparative

¹ Die Physikalischen Einwirkungen des Waldes auf Luft und Boden. Dr. Ernst Ebermeyer. Wiegandt; Hempel und Paery, Berlin, 1873.

² One precaution that I have recommended to the Director of the Forest School is for the ensuing year to exchange the gauges and measure-glasses used respectively inside and outside the forest.

observations up to the present time seem to point out in the same direction. They are as follow:—

Comparative measurements of rainfall within and without forests.

RAMGARH FOREST, DEHRA DUN.

	RAIN-GAUGES ON GROUND.			RAIN-GAUGES 60 FEET ABOVE GROUND.		
	I In forest.	O Outside.	Difference. I—O.	I In forest.	O Outside.	Difference. I—O.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
June (16th—30th) 1884	4'07	3'66	0'41	3'88	3'61	0'27
July 1884	26'46	25'64	0'82	26'44	24'72	1'72
August „	21'74	21'18	0'56	21'23	19'88	1'35
September „	18'78	17'53	1'25	18'01	17'19	0'82
October „	0'39	0'28	0'11	0'37	0'26	0'11
November „	0	0	0	0	0	0
December „	0	0	0	0	0	0
January 1885	4'48	4'20	0'28	4'63	4'56	0'07
February „	0'70	0'85	—0'15	0'67	0'77	—0'10
March „	0'39	0'48	—0'09	0'36	0'42	—0'06
April „	0'55	0'44	0'11	0'50	0'45	0'05
May „	5'99	5'35	0'64	5'79	5'06	0'73
June „	10'76	10'31	0'45	10'61	9'75	0'86
July „	9'90	9'81	0'09	9'88	9'27	0'61
August „	44'91	44'64	0'27	44'45	43'56	0'89
September „	5'51	6'24	—0'73	5'47	6'06	—0'59
October „	0	0	0	0	0	0
November „	0	0	0	0	0	0
December „	3'49	3'45	0'04	3'52	3'48	0'04
TOTALS	158'12	154'06	+4'06	155'81	149'04	+6'77

RAJAH'S FOREST, DEHRA DUN.

	RAIN-GAUGES ON GROUND.			RAIN-GAUGES 60 FEET ABOVE GROUND.		
	I In forest.	O Outside.	Difference. I—O.	I In forest.	O Outside.	Difference. I—O.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
April 1885	0'42	0'06	0'36	0'36	0'32	0'04
May „	3'99	4'69	—0'70	4'04	4'36	—0'32
June „	11'70	10'47	0'23	11'42	10'07	0'35
July „	10'63	9'81	0'82	9'58	9'47	0'11
August „	45'87	47'50	—1'63	45'87	46'99	—1'12
September „	2'46	2'43	0'03	2'41	2'40	0'01
October „	0	0	0	0	0	0
November „	0	0	0	0	0	0
December „	3'54	3'40	0'14	3'45	3'43	0'02
TOTALS	78'61	78'36	+0'25	77'13	77'04	+0'09

AJMERE-MERWARA FORESTS.

	MOHWA BIR.			MADAR HILL.			NAG PAHAR.		
	Inside.	Outside.	Difference.	Inside.	Outside.	Difference.	Inside.	Outside.	Difference.
January 1886	0'10	0'08	0'02	0'15	0'12	0'03	0'08	0'05	0'03
February „	0'04	0'03	0'01	0'02	0'02	0	0	0	0
March „	0	0	0	0	0	0	0	0	0
TOTALS	0'14	0'11	0'03	0'17	0'14	0'03	0'08	0'05	0'03

	DANTA.			RAJGARH.			DILWARA BIR.		
	Inside.	Outside.	Difference.	Inside.	Outside.	Difference.	Inside.	Outside.	Difference.
January 1886	0'30	0'32	—0'02	0'35	0'25	0'10	0'08	0'07	0'01
February „	0'05	0'04	0'01	0	0	0	0	0	0
March „	0	0	0	0	0	0	0	0	0
TOTALS	0'35	0'36	—0'01	0'35	0'25	0'10	0'08	0'07	0'01

The obvious tendency of these results is to show that the existence of forest increases the rainfall; and although, at present, the evidence is very far from conclusive, I should be by no means surprised if this tendency is confirmed by further and more rigorously conditioned experience. Even admitting this, it may however be contended that the differences shown are but small; appreciable but not important. But this would be a hasty and unwarranted conclusion. The pairs of observatories contrasted are, it must be remembered, in near proximity to each other, in all cases probably less than a mile, in some less than a quarter of a mile apart; and the influence of a forest, if real, does not abruptly end at the boundary of the forest tract, but must extend to a certain distance beyond its borders; while, for some distance within those borders, it is weakened by the proximity of the open country. Hence, any difference that may be shown by these pairs of stations in respect of rainfall, in so far as it is dependent on the presence or absence of forests, is probably considerably less in amount than would be shown, were it possible to contrast the rainfall of a large area under forest with that of the same area denuded and brought under cultivation. But it is almost impossible to institute a valid comparison of such areas on the large scale, because we can never be sure that the results are unaffected by conditions other than those which are the especial subject of the test.

If such influence is real, it may be confidently expected that the effects will be much greater in India than in Europe or most extra-tropical countries; such being the rule in the case of those meteorological actions that bear most affinity to that in question. I may cite, as an illustrative instance, the very remarkable diurnal variation of the rainfall shown by the Calcutta registers. In extra-tropical countries, any variation of the rainfall

according to the time of day is but small, and to be detected only on the comparison of a very long series of registers. But, in Calcutta, it is so marked as to be a subject of ordinary observation; and the registers of no more than seven years suffice to show that, in the hot season, the rainfall at 7 P.M., the hour of maximum, is more than twenty times as great as at 6 A.M., which is that of minimum rainfall.

The question of the influence of forests on rainfall has lately been made the subject of a very interesting paper by the eminent Russian Meteorologist Mr. A. Woeikoff. In this, he draws largely upon India for evidence in support of his view, which is substantially that which I am myself inclined to regard as probable. In some cases, doubtless, the want of local knowledge has led him to over-estimate the effect of forest, and to treat as comparable, with reference thereto, instances which are largely affected by other conditions, such as exposure to winds from a dry quarter, to the prevalence of swamps, and the influence of hills. Owing to this defect in the selection of evidence, his conclusions have not commanded that general assent, to which they may perhaps hereafter be entitled. For this, we must look to a critical discussion of the further data which our Indian rainfall records are now yielding, and to more extensive observation, under the rigorous conditions of scientific experimental enquiry, which it may be within the power of the Forest Department to carry out. But speaking for myself, I must admit that, as the result of the extended experience and enquiry of late years, I have been more and more impressed with the growing evidence in favour of the view which Mr. Woeikoff advocates, and while I must necessarily admit that crucial and convincing proof is still wanting, the general tendency of the evidence is so decidedly favourable, that I can hardly regard the long-suspected influence of forests on rainfall as a question of equally balanced probabilities.

Mr. Ribbentrop, the Officiating Inspector General of Forests with the Government of India, has lately drawn my attention to a case of an apparent increase of the rainfall in consequence of forest protection, which is certainly striking, although like other cases of the kind, defective in some particulars as evidence and therefore not decisive. In preparing the data for the chart of the average rainfall of India, published in 1883, I had noticed that, the rainfall average of most stations in the Central Provinces was somewhat higher, if derived from the previous 10 or 12 years, than when obtained from longer periods; but as very little is known of the circumstances under which the registers had been kept, I attached no special meaning to the fact. A few months since, however, Mr. Ribbentrop, starting from the fact that extensive tracts of forest, previously devastated by jungle fires with a view to the nomadic system of cultivation practised by the hill tribes, had been brought under protection in 1875, and that thereby the area of vigorous forest growth had been enormously increased, was led to enquire whether this measure had sensibly affected the rainfall, and applied to my office for such records as might throw light on the subject. Comparing the rainfall of the years subsequent to 1875 with that of the years anterior to that date, he finds that the former, in all or nearly all cases, largely exceeds the latter, and he attributes this increase to the preservation of the forests.

The region which must be chiefly affected, supposing that forest protection has really had the influence attributed to it, would be the Satpura, the hilly tract that runs across the Central Provinces between the Nerbudda and the plain of Nagpur and Raipur. For this region, we have complete rainfall registers extending from 1865 or 1867 up to the present time, at the stations enumerated in the following table. I have taken the average

of the annual rainfall from the 9 to 11 years ending with 1875, and also that of the subsequent 10 years. The comparison of the two is shown in the following table :—

	FORESTS UNPROTECTED.		FORESTS PROTECTED.		Increase of annual average.
	Period.	Average rainfall.	Period.	Average rainfall.	
		Inches.		Inches.	
Badnur	1867—1875	39·83	1876—1885	47·83	+8·00
Chhindwara	1865—1875	41·43	1876—1885	48·48	+7·05
Seoni	1865—1875	52·07	1876—1885	54·76	+2·69
Mandla	1867—1875	53·58	1876—1885	56·32	+2·74
Burha	1867—1875	64·51	1876—1885	71·65	+7·14
Bilaspur	1865—1875	41·85	1876—1885	54·81	+12·96
Raipur	1866—1875	51·59	1876—1885	54·41	+2·82
AVERAGE		49·27		55·47	+6·20

The rainfall registers of Jubbulpore at the northern foot of the Satpuras, and that of Nagpur on the south, the one extending over 40 years, the other over 37 years, show that the average rainfall of a station, if derived from a period of 10 years only, has a probable error of 5 per cent., or of between 2 and 3 inches in the case of the stations enumerated. Further, it appears from a tabular summary of the rainfall of India since 1864, that the annual average of the whole country, for the 10 years, 1876-1885, was 0·66 inch greater than that for the 11 years, 1865-1875. About half the average difference shown in the above table of the Satpura stations must then be deducted, before we are justified in regarding the increase as even probably the result of some cause locally operating. The residue may fairly be regarded as indicating some such cause, but having regard to our ignorance of the circumstances under which most of the rainfall registers have been kept, it could hardly be confidently asserted that that cause is the conservation of the forests, and no other. Nevertheless, the facts, if not logically convincing, at least may be regarded as an addition of some importance to the accumulating evidence bearing on the subject.

THE FALSE POINT CYCLONE.—*Extension of the Bengal Storm-warning System.*—On the 22nd September 1885, a cyclone, small in extent but accompanied by high storm wave, devastated the settlement of Hookeytolla at False Point in Orissa. The terrible destruction of life and property which resulted from this storm, aroused public attention to the subject of storm warnings to the coast ports, and has led to the adoption of measures for extending the system, which had been devised mainly, if not exclusively, for the protection of the port of Calcutta.

It appeared from the experience of this storm, which was one of remarkably rapid progress, that a system of weather telegraphy which furnishes only one set of reports daily, though probably, in all cases, sufficient to admit of the coast ports being warned that a storm exists over the Bay, and even to assign its approximate latitude, is insufficient to allow of any precise determination of its probable course, and therefore of the issue of

special warnings to that part of the coast which may be more immediately threatened by its onset. And although it is usual, on such occasions, to call for extra telegrams from certain stations, if the advance of a storm is rapid, these extra reports may not be received in time to allow of a further warning being issued on them, before the storm bursts on the coast.

It has, therefore, been arranged that, whenever the telegraphic reports show that a storm is in existence over the Bay, an intimation to that effect shall be sent to the Port Officers of the chief ports on the Indian coast, and that they be instructed to depend on their own observations of the wind and barometer, for taking such precautions as the approach of the storm may render necessary; it being understood that, although further warning will be sent if possible, the absence of such warning is not to be understood as implying the absence of danger. This system is now in operation.

FLOOD WARNINGS, BOMBAY.—The plan, adopted in 1884, of communicating to the district officers and Political Agents of Khandesh and Guzerat, warnings of heavy rain in the drainage basins of Tapti and Nerbudda, and also of the approach from the Bay of Bengal of storms likely to produce such rainfall, with a view of forewarning them of floods in these rivers, has been in operation during the past season.

On the 18th June the following telegram was sent to the Collectors of Ahmedabad, Kaira and the Panch Mehals, and to the Political Agents of Rewa Kantha and Mahi Kantha: "Small storm moving westwards from Bengal. May possibly bring heavy rain to Guzerat." And on the 20th, when the storm had reached the neighbourhood of Sambalpur, further notice was sent by urgent telegram to the Collectors of Khandesh, Surat and Broach, and to the Agent of the Governor General, Baroda. The Superintendents of certain Observatories in the Central Provinces were at the same time warned by telegraph to report direct by telegraph to the above officers, if heavy rain (exceeding 3 inches in the 24 hours) should be registered. This storm, however, did not travel further westward, and there was consequently no flooding of the western rivers.

On the 28th June another storm was reported. This was formed about the Sandheads on the 26th, and on the 27th and 28th, travelled rapidly towards Allahabad, pursuing therefore a much more northerly course than its predecessor. It produced a very heavy fall of rain (6 inches) at Hoshangabad, and this was at once telegraphed to the officers in Guzerat, but the storm continued its course towards the Upper Provinces, and soon after broke up. There were no floods of a disastrous character in the Western Presidency, and indeed drought and not flood was the characteristic of the season.

MARINE METEOROLOGY.—The charts of barometric pressure, winds and currents in the Bay of Bengal for each month of the year, having been recast in accordance with suggestions received from the Officers and Weather Institutes that had been consulted, as reported last year, have been lithographed, and those for several months have now been printed off. The complete work will, it is hoped, be issued in the course of the present year.

Good progress has been made with the preparation of similar charts for the Arabian Sea, and Mr. Dallas has also drawn up a set of charts, illustrating the varying density of the sea-water of the Bay of Bengal for four seasons of the year.

Weather logs relating to the Bay of Bengal are still received from Commanders of vessels reaching the port, on the plan devised and carried out by Mr. Eliot. One hundred and sixty-one of these have been received during the past year.

INSPECTION OF OBSERVATORIES.—Special arrangements were made during the past cold season for the inspection of a larger number of observatories. Mr. Dallas was deputed to inspect four of those in Rajputana and Central India, two in the Punjab, one in Bombay and one in the Central Provinces. Mr. F. Chambers to the five observatories of Berar, four others in the Central Provinces and one in Bombay. And the Meteorological Reporter to the Government of India inspected three others in the Central Provinces, and subsequently, one in Bengal, five in the North-Western Provinces, four in the Punjab, one in Beluchistan, three in Sind and four in Madras. The Meteorological Reporters for Bengal, the North-Western Provinces and Madras, and the Officiating Reporter for the Punjab have also inspected several of their observatories, and thus by one or another officer of the Meteorological Department, the following observatories reporting to the Imperial Department have been subject to inspection during the year:—

BENGAL AND ASSAM .	{	Dhubri.	CENTRAL PRO- VINCES.— <i>contd.</i>	{	Khandwa.
		Bankipore (Patna).			Chanda.
	{	Hazaribagh.		{	Raipur.
		Darjeeling.			Akola.
	{	Durbhanga.	BERAR . . .	{	Buldana.
		Calcutta (Alipore).			Chikalda.
	{	Gya.			Amraoti.
					Makhla.
	{	Benares.	CENTRAL INDIA AND RAJPUTANA . .	{	Neemuch.
		Allahabad.			Indore.
NORTH-WEST- ERN PRO- VINCES AND OUDH .	{	Agra.		{	Mount Abu.
		Lucknow.			Ajmere.
	{	Bareilly.		{	Sambhar.
		Ranikhet.			Kurrachee.
	{	Pithoragarh.	BOMBAY . . .	{	Jacobabad.
		Chakrata.			Hyderabad.
	{	Meerut.		{	Rajkot.
		Jhansi.			Surat.
	{	Dehra.		{	Malegaon.
					Bangalore.
	{	Lahore.	MADRAS . . .	{	Bellary.
		Mooltan.			Coimbatore.
PUNJAB .	{	Peshawar.		{	Cuddapah.
		Rawalpindi.			Madura.
	{	Chamba.		{	Mangalore.
		Simla.			Mercara.
	{	Ludhiana.		{	Negapatam.
		Delhi.			Salem.
	{	Sirsa.		{	Trichinopoly.
		Sialkot.			Wellington.
	{	Murree.	BELUCHISTAN .	{	Quetta.
CENTRAL PRO- VINCES .	{	Nagpur.		{	
		Jubbulpore.			
	{	Pachmarhi.		{	
		Hoshangabad.			
	{	Seoni.		{	

About half the observatories have therefore been inspected during the past year.

PART II.—DETAILS OF ADMINISTRATION.

OBSERVATORIES.

At the commencement of the year under report, there were 128 observatories in India and elsewhere, contributing original registers to this office. A new observatory was opened at Tezpur in Assam on the 2nd April 1885, and a voluntary observatory, furnished with instruments from this office, has been established at Baroda and began work on the 26th January 1886. There have also existed observatories at Calicut and Coconada for some years past in connection with the Bombay and Bengal Storm-warning Systems, but the registers have not been communicated to the Central Office. These have now been called for.

On the other hand, the voluntary observatory at St. Fidelis' School, Mussooree, had become so irregular in its working, as to be of little or no value to the department, and the instruments were therefore withdrawn in November 1885, the registers having ceased some months previously. Thus, at the close of the year, there were 131 observatories working in connection with the department. These are enumerated in the following list which also specifies the class to which they belonged at the close of the year. The classes are:—

- 1st Class*, furnished with autographic instruments for pressure, temperature, humidity, rainfall and wind registration, either continuously or at short (10 minutes') intervals.
- 2nd Class*.—Hourly observations recorded on four days in each month; on other days, 3 times during the day. Or observations recorded daily 4 times at intervals of 6 hours. Certain of these observatories are also furnished with anemographs for the continuous registration of the wind.
- 3rd Class*.—Observations of pressure, temperature, &c., recorded twice daily, *viz.*, at 10 A.M. and 4 P.M., and measurement of rainfall at 6 P.M.
- 4th Class*.—Observations of temperature, wind and rainfall only, similarly recorded.

BENGAL AND ASSAM.

	Class.		Class.		Class.
Dhubri . . .	2nd	Darjeeling . . .	3rd	Calcutta (Alipore) .	1st
Tezpur . . .	3rd	Purneah . . .	"	Do. (Chowringhee) .	4th
Sibsagar . . .	"	Durbhanga . . .	"	Demagiri . . .	"
Silchar . . .	"	Gya . . .	"	Mongpoo . . .	"
Bankipore (Patna) .	"	Berhampore . . .	"	Tura . . .	"
Hazaribagh . . .	"	Burdwan . . .	"	Pedong . . .	3rd
Saugor Island . . .	2nd	Jessore . . .	"		
Cuttack . . .	3rd	Dacca . . .	"		
Chittagong . . .	"	False Point . . .	"		

NORTH-WESTERN PROVINCES AND OUDH.

	Class.		Class.		Class.
Allahabad . . .	1st	Mussooree (Surveyor Genl.'s office) .	3rd	Meerut . . .	3rd
Agra . . .	3rd	Dehra (Surveyor Genl.'s office) .	"	Gorakhpur . . .	"
Lucknow . . .	"	Do. (Forest School) .	4th	Ghazipur . . .	"
Roorkee . . .	"	Bareilly . . .	3rd	Benares . . .	"
Chakrata . . .	"			Jhansi . . .	"
Ranikhet . . .	"			Pithoragarh . . .	"

PUNJAB.

	Class.		Class.		Class.
Lahore . . .	2nd	Murree . . .	3rd	Kailang . . .	3rd
Mooltan . . .	3rd	Sialkot . . .	"	Delhi . . .	"
Dera Ismail Khan . . .	"	Ludhiana . . .	"	Sirsa . . .	"
Peshawar . . .	"	Chamba . . .	"		
Rawalpindi . . .	"	Simla . . .	"		

CENTRAL PROVINCES.

	Class.		Class.		Class.
Nagpur . . .	2nd	Hoshangabad . . .	3rd	Sironcha . . .	3rd
Jubbulpore . . .	"	Seoni . . .	"	Raipur . . .	"
Pachmarhi . . .	"	Khandwa . . .	"	Sambalpur . . .	"
Saugor . . .	3rd	Chanda . . .	"		

BERAR.

	Class.		Class.		Class.
Akola . . .	3rd	Chikalda . . .	3rd	Makhla . . .	4th
Buldana . . .	"	Amraoti . . .	"		

CENTRAL INDIA AND RAJPUTANA.

	Class.		Class.		Class.
Jeypore . . .	1st	Indore . . .	3rd	Sambhar . . .	3rd
Sutna . . .	3rd	Mount Abu . . .	"	Bickaneer . . .	"
Nowgong . . .	"	Pachpadra . . .	"		
Neemuch . . .	"	Ajmere . . .	"		

BOMBAY.

	Class.		Class.		Class.
Colaba (Bombay) . . .	1st	Jacobabad . . .	3rd	Baroda . . .	3rd
Belgaum . . .	2nd	Hyderabad (Sind) . . .	"	Surat . . .	"
Poona . . .	"	Bhuj . . .	"	Malegaon . . .	"
Deesa . . .	"	Rajkot . . .	"	Ratnagiri . . .	"
Kurrachee . . .	"	Sholapur . . .	"	Karwar . . .	"

MADRAS.

	Class.		Class.		Class.
Vizagapatam . . .	2nd	Kurnool . . .	3rd	Madura . . .	3rd
Bellary . . .	"	Cuddapah . . .	"	Calicut . . .	"
Trichinopoly . . .	"	Madras . . .	"	Wellington . . .	"
Gopalpur . . .	3rd	Bangalore . . .	"	Mercara . . .	"
Coconada . . .	"	Negapatam . . .	"	Mangalore . . .	"
Masulipatam . . .	"	Salem . . .	"	Rajamundry . . .	"
Secunderabad . . .	"	Coimbatore . . .	"	Cochin . . .	"

BURMA.

	Class.		Class.		Class.
Rangoon . . .	2nd	Akyab . . .	3rd	Toungoo . . .	3rd
Bassein . . .	3rd	Thayetmyo . . .	"	Moulmein . . .	"
Diamond Island . . .	"	Mergui . . .	"		

BAY ISLANDS.

	Class.		Class.
Port Blair . . .	3rd	Nancowry . . .	3rd

EXTRA INDIAN.

	Class.		Class.		Class.
Leh	2nd	Bushire	3rd	Katmandu	3rd
Aden	"	Quetta	"	Amini Divi (Lakha- dives)	"

During the year the following observatories, formerly of the second class, having contributed hourly observations for at least ten years, were reduced to the third class, excepting that the anemographs have been retained at those stations which possessed them, and the synoptic observations, recorded at Greenwich mean noon, are continued:—

Roorkee	Patna	Sibsagar
Agra	Hazaribagh	Chittagong
Lucknow	Cuttack	

and one, *viz.*, Allahabad, has been raised to the status of a first class observatory.

OBSERVATORIES IN BENGAL AND ASSAM.—*The Alipore Observatory.*—This observatory serves as a general depôt for the verification of instruments, as well as for observations of an experimental character, and an important part of the work is the working of the time signals for the port of Calcutta. It is immediately superintended by the Reporter to the Government of India, and the establishment is under the charge of the Chief Observer, Babu Brojo Mohun Rakhit, B.A. During the past year the work of the observatory has consisted of—

- 1st.—Continuous registration, by autographic instruments, of (a) the duration of bright sunshine, (b) the atmospheric pressure, (c) temperature, (d) moisture (dry and wet bulb thermometers), (e) wind direction, movement and pressure, and (f) rainfall.
- 2nd.—Periodical readings, five times daily, of the barometer, dry and wet bulb thermometers, measurements of rain and estimates of cloud proportion, once daily of the maximum and minimum thermometers in shade, those of the exposed thermometers for nocturnal radiation and insolation, and thrice daily those of ground thermometers at the surface, 1 foot, 3 feet, and once at 6 feet deep. Also occasional observations on the movements of the higher clouds by means of the nephoscope.
- 3rd.—The verification of all thermometers issued to observatories throughout India, with the exception of those under the Meteorological Reporter for Western India, and the comparison of all barometers with the Calcutta standard.
- 4th.—The determination of the mean local time, by meridian observations of the sun, and the working of the time signals for the guidance of the shipping in the port. Also the custody and rating of Government chronometers.

The establishment for the above purposes consists of—

- Babu Brojo Mohun Rakhit, B.A., Chief Observer.
- „ Annoda Prosad Banerjee, B.A., 1st Photo. Assistant.
- „ Ram Chandra Chackravarty, 2nd ditto.
- „ Mahendro Nath Banerjee, Observer.
- „ Shyam Lall Sen, Observer.
- 2 Artificers.
- 1 Batteryman.
- 6 Servants.

The autographic instruments consist of a sunshine recorder, the Kew barograph and thermograph, which register by photography, a Beckley's anemograph, and Osler's anemometer and a Beckley's rain-gauge. During the past year, with but slight exceptions, the instruments have worked well.

The interruptions of the photographic records though more frequent than is desirable,

owing chiefly to the imperfect working of the instruments, have been of short duration, rarely exceeding one or two hours.

It was mentioned in last year's report, that in March 1884, a bubble of air had penetrated the Torricellian vacuum of the barograph barometer-tube, causing a depression of the column and altering the zero value of the instrument. Since then, the barograph trace measurements at the hours of reading the standard barometer have been compared with the eye readings of the latter instrument month by month, and a correction applied to the former to equalize them to the latter. The results of these comparisons are given in the following table:—

Comparative mean reduced readings of barograph and standard barometer in 1885.

1885.	STANDARD BAROMETER.					BAROGRAPH.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
January	30'070	30'144	30'013	30'076	30'076	30'038	30'119	29'986	30'051	30'049
February	29'951	'025	29'901	29'964	29'960	29'923	'002	'876	29'942	29'936
March	'897	29'963	'833	'910	'901	'873	29'943	'811	'892	'880
April	'746	'804	'670	'756	'744	'726	'786	'648	'739	'725
May	'744	'792	'674	'743	'738	'722	'771	'649	'723	'716
June	'552	'588	'491	'578	'552	'521	'558	'456	'549	'521
July	'539	'574	'490	'572	'544	'504	'551	'458	'547	'515
August.	'552	'594	'507	'591	'561	'516	'566	'469	'558	'527
September	'726	'778	'678	'760	'736	'698	'760	'648	'736	'711
October	'864	'921	'808	'878	'868	'841	'903	'782	'857	'846
November	'983	30'045	'934	30'006	'992	'963	30'029	'909	'987	'972
December	30'023	'089	'973	'040	30'031	30'004	'074	'952	30'022	30'013
YEAR	29'804	29'860	29'748	29'823	29'809	29'777	29'839	29'720	29'800	29'784

The constancy of the standard (Newman's No. 109, with a constant correction of —0'005 to assimilate it to the old Calcutta standard,) is verified by series of comparative readings, made at intervals of 6 months, with two other barometers of similar construction; (Newman's No. 86 and No. 112.) If there has been any change in their relative values since July 1883, it is in a slight depression of the two secondary standards or perhaps in No. 109 only, but this is doubtful.

The following table gives a comparison between the eye readings of the compared and corrected thermometers under the thermometer shed at Alipore, with the corresponding thermograph traces, which shows that the relative values of the dry bulbs have remained unaltered. The difference of the wet bulbs has apparently increased by 0'2°, but as the exposure of the instruments is not the same, it may be due to some change in the local conditions affecting the readings.

Comparative mean readings of the thermograph and dry bulb thermometer in the thermometer shed in 1885.

1885.	THERMOMETER IN SHED.					THERMOGRAPH (DRY BULB.)				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	°	°	°	°	°	°	°	°	°	°
January	58'7	69'4	76'9	62'7	66'9	59'5	68'1	75'4	63'2	66'6
February	61'0	70'7	77'2	65'1	68'5	62'0	70'2	76'4	65'9	68'6
March	70'9	82'1	88'8	75'5	79'3	72'0	81'4	88'1	76'5	79'5
April	76'8	89'9	97'0	80'9	86'2	78'2	89'6	96'6	82'4	86'7
May	78'1	89'4	91'4	80'4	84'8	79'4	89'9	91'9	81'7	85'7
June	80'6	87'1	88'2	81'6	84'4	81'5	88'0	89'1	82'5	85'3
July	79'4	84'6	85'2	80'8	82'5	80'3	85'3	86'1	82'4	83'5
August	78'9	82'0	82'0	79'7	80'7	79'5	82'4	82'8	80'3	81'3
September	78'8	83'6	84'3	80'5	81'8	79'5	83'9	85'0	81'2	82'4
October	75'7	83'3	84'6	77'1	80'2	76'6	83'0	84'7	78'0	80'6
November	65'9	75'5	79'4	68'8	72'4	66'9	75'0	78'8	69'6	72'6
December	59'0	68'2	73'6	61'9	65'7	59'7	67'2	72'7	62'3	65'5
YEAR	72'0	80'5	84'1	74'6	77'8	72'9	80'3	84'0	75'5	78'2

Comparative mean readings of the thermograph and wet bulb thermometer in the thermometer shed in 1885.

1885.	WET BULB IN SHED.					THERMOGRAPH (WET BULB.)				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	°	°	°	°	°	°	°	°	°	°
January	57'1	61'6	63'6	60'3	60'7	57'0	61'0	63'3	60'3	60'4
February	59'3	62'3	64'0	61'8	61'9	59'6	62'1	64'1	62'2	62'0
March	69'2	72'1	70'5	71'4	70'8	69'6	72'4	71'9	72'1	71'5
April	73'7	75'6	73'0	75'7	74'5	74'5	76'7	75'1	76'6	75'7
May	75'4	78'1	76'3	75'1	76'2	76'3	79'8	78'4	76'4	77'7
June	78'6	80'2	79'9	78'5	79'3	79'0	81'1	80'8	79'0	80'0
July	78'2	80'2	80'3	79'0	79'4	78'6	80'9	81'2	79'5	80'1
August	77'7	78'9	78'8	78'2	78'4	78'0	79'3	79'5	78'5	78'8
September	77'2	79'0	79'0	78'1	78'3	77'7	79'8	80'2	78'7	79'1
October	74'6	76'5	75'5	75'2	75'5	75'2	77'4	76'6	75'8	76'3
November	64'0	67'6	68'0	66'3	66'5	64'5	67'7	68'4	66'8	66'9
December	57'3	61'8	62'7	59'6	60'4	57'3	61'4	62'9	59'7	60'3
YEAR	70'2	72'8	72'6	71'6	71'8	70'6	73'3	73'5	72'1	72'4

The sunshine recorder has continued to work satisfactorily. The observations of ground temperature have been carried on as in the previous year. An abstract of the registers is given in the report on the Meteorology of India in the year 1885.

The number of instruments verified at the Alipore Observatory, during the year ending 31st March 1886, is as follows. Excepting aneroids and solar radiation thermometers, rain-gauges and measure-glasses, the number is considerably below that tested in the previous year.

Instruments.										No.
Barometers	.	.	.	.	.	.	.	.	.	42
Aneroids	.	.	.	.	.	.	.	.	.	27
Dry and wet bulb thermometers	.	.	.	.	.	.	.	.	.	8
Maximum thermometers for air temperature	.	.	.	.	.	.	.	.	.	7
Minimum do. do. do.	.	.	.	.	.	.	.	.	.	27
Do. do. for nocturnal radiation	.	.	.	.	.	.	.	.	.	28
Solar radiation thermometers	.	.	.	.	.	.	.	.	.	55
Standard thermometers	.	.	.	.	.	.	.	.	.	5
Six's do.	.	.	.	.	.	.	.	.	.	1
Sling do.	.	.	.	.	.	.	.	.	.	5
Common do.	.	.	.	.	.	.	.	.	.	2
Clinical do.	.	.	.	.	.	.	.	.	.	1
Salinometer	.	.	.	.	.	.	.	.	.	1
Rain-gauges	.	.	.	.	.	.	.	.	.	17
Measure-glasses for rain-gauges	.	.	.	.	.	.	.	.	.	27
Sunshine recorder	.	.	.	.	.	.	.	.	.	1
TOTAL										254

The following is a return of the instruments received and issued by the observatory. The instruments' store is now attached to the Calcutta Meteorological Office.

Instruments.										Received.	Issued.
Barometers	.	.	.	.	.	.	.	.	.	52	32
Aneroids	.	.	.	.	.	.	.	.	.	17	16
Dry and wet bulb thermometers	.	.	.	.	.	.	.	.	.	8	10
Maximum thermometers for air temperature	.	.	.	.	.	.	.	.	.	12	18
Minimum do. do. do.	.	.	.	.	.	.	.	.	.	17	28
Do. do. for nocturnal radiation	.	.	.	.	.	.	.	.	.	27	25
Solar radiation thermometers	.	.	.	.	.	.	.	.	.	44	56
Standard thermometers	.	.	.	.	.	.	.	.	.	0	4
Six's do.	.	.	.	.	.	.	.	.	.	1	1
Common do.	.	.	.	.	.	.	.	.	.	2	2
Clinical do.	.	.	.	.	.	.	.	.	.	1	1
Salinometer	.	.	.	.	.	.	.	.	.	1	1
Sunshine recorder	.	.	.	.	.	.	.	.	.	1	1
Traveller's maximum and minimum thermometers	.	.	.	.	.	.	.	.	.	12	0
Rain-gauges	.	.	.	.	.	.	.	.	.	17	17
TOTAL										212	212

The time signals have worked satisfactorily, though the occasions of failure have been somewhat more numerous than in the previous year. Both balls dropped correctly on 280 days; one failed on four days, the other on two days, making six failures in all,

but as these occurred on different days, one or the other ball gave a correct time signal on 286 days. The remaining days (79) were either Sundays or public holidays.

Table showing the occasions of failure of two time balls during the official year 1885-86.

Dates of failures.	Number of failure.		
8th April 1885 . . .	Time ball on the Semaphore tower, Fort William, dropped a few seconds late.		
27th April 1885 . . .	Ditto	ditto	ditto.
29th May 1885 . . .	Ditto	ditto	ditto.
11th July 1885 . . .	Ditto	ditto	ditto.
17th October 1885 . .	Time ball at the Port Commissioners' Office failed altogether.		
5th February 1886 . .	Ditto	ditto	ditto.

On a representation from ship masters in the port, of the inconvenience arising from the suspension of the time signal service on Sundays and holidays, and also of the importance of signalling at once to the shipping any inexactitude in the working of the signals, this office has been in correspondence with the Government of Bengal, with a view to making the service continuous, and also of providing means for signalling the occurrence of a failure. The subject is still under the consideration of the Bengal Government.¹

OTHER OBSERVATORIES IN BENGAL AND ASSAM.—A list of the observatories reporting to the office of the Imperial Government has been given at page 16. Those reporting only to the Provincial Office are enumerated below in a foot-note.²

Some extracts from Mr. Pedler's report, on the condition and working of the observatories under his charge, is given in Appendix A. Of the observatories on the Imperial list, ten (exclusive of the two Calcutta observatories) have been inspected during the past year, *viz.*, Darjeeling, Bankipore (Patna), Dhubri, Hazaribagh and Durbhanga, by Mr. Pedler, Gya by myself, and Saugor Island, Purneah, Jessore and Dacca by Mr. Pedler's Head Clerk. That of Dhubri, formerly an excellent observatory, was found to be in a very unsatisfactory condition, owing to the incompetence of the man, (formerly Assistant observer,) who had been appointed Observer on the death of his predecessor. He has been given notice of dismissal and his place will shortly be supplied by a man trained to his work at Alipore.

The site of the Purneah Observatory has deteriorated in point of exposure, owing to the growth of trees round about it, and it will have to be removed, however much such a step may be regretted on general grounds.

¹ Since the above was written, the proposals have been sanctioned and the service is now uninterrupted.

² The observatories established for the system of daily local report in Bengal are the following :—

Balasore.	Furreedpore.	Bhagalpore.	Nya Doomka.
Midnapore.	Mymensingh.	Chupra.	Ranchee.
Raneegunge.	Rampore Bauleah.	Motiharee.	Chybassa.
Noakholly.	Dinagepore.	Buxar.	Bogra.
Burrisal.	Rungpore.	Arrah.	Maldah.
Serajganj.	Bankoora.	Krishnagar.	
Comillah.	Julpigoree.	Dehree.	

The Jessore Observatory was found to be in an unsatisfactory condition, and the special allowance previously granted to the Observer has been suspended in consequence.

The Dacca Observatory was also found to be somewhat defective. That of Gya, which was inspected by myself in December; was, on the whole, better than I had expected, but the Meteorological Reporter to the Government of Bengal has had occasion to censure the Observer on more than one occasion, and it is certain that, from whatever cause, his barometric registers have been open to much doubt.

The False Point Observatory was seriously injured in the cyclone of the 23rd September, the thermometer shed being blown away, and the anemometer blown down. Very valuable observations of the barometer were made during the passage of this storm by Mr. Workman, the Observer. Telegraphic communication with Calcutta was in abeyance up to the 6th January, and during this interval, the storm signal service was deprived of one of its most important reporting stations.

A new observatory of the 3rd class has been established at Tezpur, in Assam. It began to work on the 2nd April 1885, but, as yet, has hardly been up to the required standard.

Respecting other observatories in Bengal and Assam, there is little to remark. They have worked satisfactorily, and in many cases excellently well.

Special allowances have been granted for the present year to the Observers enumerated as follows :—

Names.	Stations.	Amounts.
		R
Makhadaprosad Chowdhuri	Burdwan	10
Mahendra Nath Roy	Berhampore	10
Dandadhar Datta Barua	Sibsagar	10
W. H. Alley	Cuttack	5
Nathu Lall	Hazaribagh	5
Ramesh Chundra Bhadra	Silchar	5
Jogin Chundra Banerji	Durbhanga	5

OBSERVATORIES IN THE N.-W. PROVINCES AND OUDH.—It has already been noticed, in Part I of this report, that the observatory at Allahabad, hitherto ranking as one of the 2nd class, has been raised to the status of a 1st class observatory, and has been removed to the new building specially constructed for it in the Chatham lines, and furnished with a meteorograph which records autographically. Readings of the ordinary instruments are recorded by eye at intervals from 5h. 50m. A.M. up to 10 P.M., but the hourly readings of all instruments, formerly recorded on four days in each month during 25 hours in succession, have been discontinued, as well as those hitherto taken daily at 4 A.M.

As the removal of an observatory always introduces some change in the normal or average temperature, humidity, &c., no two sites being exactly alike in these respects; and as it is a matter of great importance that the registers of any future year shall be rigorously comparable with those of past years, observations have been made simultaneously, twice a day, at the new and old observatories, since the beginning of September 1884, and they will be continued till the expiration of two complete years. In the extracts from his Administration Report, (Appendix B,) Mr. Hill notices the differences, which have thus become apparent, in the effects of the two sites on the instruments, and traces them to their probable causes.

The establishment of the Allahabad Observatory consists of—

Babu Kader Nath Chatterjee, Head Observer.
 „ Sashibhusun Banerjee, Second „
 „ Jadu Nath Chatterjee, Third „
 1 Electrician occasionally and casually.
 1 Artificer „ „
 1 Printer „ „
 and 4 menial servants.

The work of the observatory consists of—

1st.—Registering autographically, at intervals of ten minutes, by means of Van Rysselberghe meteorograph, the readings of the barometer, dry and wet bulb thermometers, direction and distance travelled by the wind, and the amount of the rainfall. The register is engraved on a prepared metallic plate, which is afterwards etched, and from which any required number of copies can be printed off.

2nd.—Periodic readings, five times daily, of the barometer, dry and wet bulb thermometers, &c., &c., and once daily of maximum, minimum air temperature, and radiation thermometers, and thrice daily of the ground thermometers at the surface, 1 foot, 3 feet and 9 feet deep, &c., as at the Alipore Observatory. Also the registering of the duration of bright sunshine, and observations on the movements of the higher clouds with a Marie Davy nephescope.

The meteorograph having been brought into good working order, only at the end of the year, no comparison has yet been made between its registers and the eye readings of the ordinary instruments. The latter will continue to furnish the standard values, and the registers of the autographic instruments corrected to them when necessary.

The new observatory accommodates the Meteorological Reporter's Office as well as the observatory establishment.

The three observatories of Lucknow, Agra and Roorkee have hitherto worked as second class observatories, furnishing, in addition to three daily series of observations, hourly readings of all instruments for 25 consecutive hours, four times in each month. As more than ten years of these registers have now been recorded, and these suffice to show the normal diurnal variation of the chief meteorological elements, the hourly registers were discontinued at the end of 1885, and a reduction made in the cost of these observatories. Since the beginning of the present year, they have furnished the same observations as 3rd class stations, with the addition of synoptic observations as a part of the international system in correspondence with the United States Meteorological Department, and which it is intended to continue indefinitely.

In June and July, the observatory at Lucknow was, in part, transferred to a different but neighbouring building, the Tashat Baksh. The change, thus introduced, really however affects only the wind registers, the anemograph having been set up on the roof of the present building. The barometer, in a lower room, is at exactly the same elevation as formerly, and the thermometer shed and instruments have not been moved. The observatory was inspected by Mr. Hill in April 1885, and everything found to be in a satisfactory condition.

Roorkee Observatory has not been visited, but has continued to work well.

The Agra Observatory was visited by myself in December 1885 and found to be

in very good order. The chief instruments were re-verified, the barometer cistern cleaned, &c.

Other observatories in the North-Western Provinces, inspected by myself on this tour, are those of Benares, Meerut and Chakrata, and I also visited that attached to the Office of the Survey of India at Dehra. Mr. Hill has inspected Bareilly, Ranikhet, Pithoragarh and Jhansi, also the Benares Observatory on more than one occasion. At all these the barometers and thermometers were re-verified. The observatories of Benares, Chakrata, Pithoragarh and Ranikhet were found to be in excellent order; the others somewhat less so. The Observers at Jhansi and Gorakhpur have both been fined for carelessness. Special meritorious allowances have been conferred on the following Observers for the ensuing year:—

Names.	Stations.	Amounts. R.
Chotay Lall	Lucknow	10
Jewa Nand	Ranikhet	10
Chiranjil Lall	Roorkee	10
Mir Altaf Ali	Agra	5
Sher Singh	Pithoragarh	5

OBSERVATORIES IN THE PUNJAB.—The observatories in this Province are the same in number and position as in the previous year, and they are enumerated on page 17. Chamba and Kailang are immediately under the Imperial Office, the remainder, under the Meteorological Reporter to the Punjab Government.

The Lahore Observatory still awaits the arrival of some of the autographic instruments, required for its outfit as an observatory of the 1st class. A self-registering rain-gauge and a Beckley's anemograph have been received, but a tower has yet to be built for the latter, and the former did not reach Lahore until after the close of the year.

Meanwhile, the observatory is carried on as one of the 2nd class, hourly observations being recorded on four days in each month. In addition to the observations made at other observatories of the same class, a register is kept of the ground temperature, from the surface down to 6 feet below it; and also the duration of bright sunshine by means of a sunshine recorder. Up to the end of November 1885, the observatory was under the immediate superintendence of the Meteorological Reporter to the Punjab Government, whose residence was in Lahore. But on the transfer of the Meteorological Reporter's duties to Mr. Dallas, whose head-quarters, as 1st Assistant to the Meteorological Reporter to the Government of India, are at Simla, and who permanently resides there, it became necessary to make another provision for the superintendence of the observatory, and Mr. Oman; who had officiated as Meteorological Reporter from the time of Dr. Lawrie's departure up to Mr. Dallas's assumption of that office, was appointed Superintendent of the Lahore Observatory.

A duplicate set of observations (on the scale of a 3rd class station,) is carried on at the old observatory at the Mayo Hospital, in order to determine the effect of the change of site on the normal readings of the chief instruments.

During his tenure of office as Meteorological Reporter, Mr. Oman visited the observatories of Peshawar, Murree, Rawalpindi, Sialkot, Mooltan, Ludhiana, Delhi, and Sirsa. Mr. Dallas, besides visiting Lahore, inspected the Chamba Observatory, and

during my cold-weather tour, or subsequently, before proceeding to Simla, I inspected Lahore, Mooltan, Peshawar and Rawalpindi, and verified the instruments. The less accessible observatories of Dera Ismail Khan, Kailang and Leh have alone remained unvisited.

The observatories of Lahore, Peshawar, and Murree have been found, on the present as on former occasions of inspection, in excellent condition, and the work carefully and accurately performed. That of Rawalpindi was satisfactory on the occasion of my visit, and that of Mooltan also, there having been a marked improvement in its condition since it had been inspected by Mr. Oman in September 1885; that of Sialkot is stated to be satisfactory on the whole, the instruments clean and well cared for, but some small defects were noticed. The reported conditions of the Delhi and Sirsa observatories seem to afford evidence of much neglect, and that of Ludhiana observatory, though better, is not satisfactory. It is to be regretted that Mr. Oman, instead of seeing that the defects noticed were remedied at once, merely reported them to the Superintendents after his return to Lahore, and requested that the observer might be directed to correct them.

The Chamba Observatory was inspected by Mr. Dallas in November 1885. The barometer and anemometer were found to be out of order, and had to be replaced. The thermometers were in good order, but not securely suspended, and exposed to shaking by the winds. The observer is Dr. Barkhurdar Khan, a medical officer in the employ of the Rajah of Chamba, by whom he is allowed to act in the above capacity. The thermometer shed is provided at the Rajah's expense.

The Kailang Observatory has been carried on with the greatest care and attention by the Superintendent, the Reverend A. W. Heyde. In addition to the usual registers, Mr. Heyde has contributed most valuable information respecting the climate and variations of the snowfall, and has carried out a series of experimental measurements, comparing the thickness of a fall of snow with the quantity of water yielded on melting it, which have resulted in showing—1st, that the thickness of a fall of snow, if measured with due precaution and immediately after its fall, bears a nearly constant relation to the quantity of snow-water which it yields; and, 2nd, that under ordinary circumstances and when the fall is not such as to choke the gauge, the ordinary rain-gauge serves to give a very trustworthy measurement of the fall.

A list of the Superintendents and Observers is given in Appendix C.

Special meritorious allowances have been awarded to the following Observers for the ensuing year :—

Names.	Stations.	Amount. R.
Jaspat Rai	Lahore	10
Devan Chand	„	5
Kashi Ram	Peshawar	5
W. Cruikshank	Murree	5
Sergeant J. J. Konig	Simla	5

OBSERVATORIES IN THE CENTRAL PROVINCES.—These are the same as in previous years, and are enumerated at page 17.

Except those at the less accessible stations of Saugor, Sambalpur and Sironcha, all the observatories have been inspected during the year, five of them by the Sanitary Commissioner as well as by officers of the Meteorological Department. Khandwa was

inspected by Mr. Dallas; Nagpur, Raipur, Seoni and Chanda, under instructions from my office, by Mr. Chambers; and Hoshangabad, Pachmarhi and Jubbulpore by myself in November last.

The Nagpur Observatory was found to be in excellent order as regards all the ordinary instruments, and the observer P. Soobiah read all the instruments accurately. But the large anemograph was found to be working very stiffly for want of cleaning. This was effected before Mr. Chambers's departure. The sunshine recorder supplied to Nagpur had not been set up at the time of Mr. Chambers's inspection.

Jubbulpore and Pachmarhi, the other two observatories of the 2nd class, were inspected by myself. The Jubbulpore observatory was generally in good condition. The sun thermometer, being however defective in action, was withdrawn. The wind-vane had become worn and worked stiffly, and owing to the greasiness of the thread, the hygrometer wet bulb had gone dry.

At Pachmarhi things were less satisfactory. The observer appeared to neglect his duty, and to pay but little attention to the official instructions. The ordinary instruments, with the exception of the sun thermometer, were in fair condition, but the large anemograph was in a state similar to that of Nagpur, having never been cleaned since it was put up. The instrument was taken to pieces during my visit and put into the hands of the regimental armourer for the purpose.

At Seoni, the anemometer wanted cleaning, and a minimum thermometer was not in workable condition, but this last does not imply any neglect on the part of the observer, who is an intelligent, painstaking man, but one who has never had any regular training at a standard observatory.

At Raipur, which had not previously been visited by any officer of the Department, several small matters required remedying; but, in general, the instruments appeared well cared for, and the observer read them accurately.

With the exception of the anemometer and wind-vane, which required cleaning, the state of the Chanda Observatory and the work of the observer were equally satisfactory.

The Khandwa Observatory, which was inspected by Mr. Dallas in January 1886, was found to be in good order; the instruments clean and well exposed. With the exception, that the wind-vane required oiling, the anemometer was rather sheltered by a tree, and that the sun thermometer had been somewhat injured in transport; there was little or nothing requiring to be remedied.

The Hoshangabad Observatory was inspected by myself in November 1885. The wind-vane and anemometer are screened by a large tree to the north-west. The barometer, thermometers and all other instruments were found to be in good condition, but the observer does not always read them correctly.

Special allowances have been awarded to the following Observers in the Central Provinces for the ensuing year :—

Names.	Observatory.	Amount. R.
Seetaram	Chanda	5
Pancham	Seoni	5
P. Soobiah	Nagpur	5
Behary Lall Parasar	Khandwa	5
Jadunath Basu	Saugor	5

OBSERVATORIES IN BERAR.—These are the same as in former years—five in number—of which one, at Makhla, is a 4th class observatory, established and carried on by the Forest Department.

All these were visited and inspected by Mr. F. Chambers in 1886. At Amraoti, the thermometer shed was found to be well placed, but the anemometer was on a post only 6 feet high, surrounded by trees and buildings. The barometer was very dirty, as also were certain other instruments, but the observer, though apparently careless, knew how to read his instruments correctly.

At Akola, everything was found in excellent condition as far as depended on the observer. But the barometer and sun thermometer had somewhat deteriorated owing to natural causes, and the observer, although careful and conscientious in his work, appears not to be thoroughly acquainted with the proper mode of performing it.

The Buldana Observatory was removed to a new site at the civil hospital in 1885, and comparative observations are now made at both the old and new sites to determine the difference of their conditions. The barometer had become somewhat dim, but was still in serviceable condition. The thermometers and most of the instruments were in good order, and the observer knew how to read his instruments correctly.

At Chikalda, the wind-vane and anemometer were found to be in a bad position, and the sun-dial was not correctly set in azimuth. Except that the barometer cistern had become somewhat dim, the instruments generally were in excellent condition, and the observer is reported to be intelligent and to read his instruments accurately.

Makhla is an observatory in the forest, surrounded by trees, and the wind observations are of little value on this account. The hygrometer was found to be too much enclosed to show the true humidity of the air, but in general the arrangements were fairly satisfactory, and the observer intelligent.

A nominal list of Superintendents and Observers at the Berar stations is given in Appendix C. The following Observers have been re-allotted special allowances during the current year :—

Names.	Observatory.	Amount. R
Samuel Gregory	Akola	10
Hera Lall	Chikalda	5
Bukaram Pandurang	Amraoti	5

OBSERVATORIES IN CENTRAL INDIA AND RAJPUTANA.—These are the same as in previous years, and are enumerated on page 17. The Maharaja's observatory at Jeypore, which is a 1st class observatory, sends its registers to the Reporter for the North-Western Provinces and Oudh.

Of the remaining observatories, those of Nowgong, Sutna, Ajmere and Sambhar are under the Meteorological Reporter for the North-Western Provinces and Oudh. Those of Neemuch, Indore, Mount Abu and Bickaneer, report to the Meteorological Reporter for Western India, and that of Pachpadra, sends its registers direct to the Central Office.

The observatories of Jeypore, Sambhar, Ajmere, Mount Abu, Neemuch and Indore were visited and the Government observatories inspected by Mr. Dallas, 1st Assistant Meteorological Reporter to the Government of India, in December and January.

The Sambhar Observatory was in a somewhat neglected condition; the thermometers dirty and in some cases not acting properly, and the shed in bad repair. The observer's practice was also in some respects erroneous. The barometer was, however, in good condition and properly suspended.

Ajmere Observatory has become much deteriorated in point of exposure, owing to the growth of shrubs and trees round about it, the observatory being situated in the public garden. The thermometers were dirty and the graduations almost obliterated. The anemometer and wind-vane were in good order and the latter correctly set. It has become necessary to remove the observatory to a more open site, and with the permission of the Principal, Major Loch, it will be moved to the Mayo College.

Mount Abu was found to be in good order, and the observer is reported to take great interest in his work. The thermometer shed was rather small, and one or two instruments were old, but otherwise there was little calling for remark.

The Neemuch Observatory was also in very satisfactory condition as far as depended on the observer. The arrangements for recording the wind involved some inconvenience and probable inaccuracy, and these have been since improved.

The Indore Observatory was less satisfactory, the barometer being very dirty and scarcely readable. The thermometer shed and fences were, however, in good order, but the exposure has been somewhat injured by low buildings and large heaps of building materials round three sides of it. Its position too is said to be objectionable, being too much in a hollow to be fairly representative of the climatological conditions of the country around. The wind arrangements are reported as unsatisfactory, which is also the case at many other stations in Western India, where, on principle, a piece of rag has been made to do duty for a vane. The resulting practice is frequently of the most primitive character and involves much guessing.

The observatories at Sutna, Nowgong, Pachpadra and Bickaneer have not been inspected. The first is, however, known to be excellently conducted, and the second is believed to be excellently supervised. The other two are probably in want of inspection, and this will be effected as soon as they are more accessible than at present.

Special allowances have been granted or renewed to the following Observers in Rajputana and Central India:—

Names.	Stations.	Amount. R.
Harnath	Sutna	10
Rampershad	Ajmere	5
Trimbak Rao	Indore	5

OBSERVATORIES IN BOMBAY.—These, excepting the Colaba Observatory, are all under the Meteorological Reporter for Western India.

Of the four 2nd class observatories, Kurrachee was inspected by myself in January, the others have not been visited during the year. Of the 3rd class observatories the Reporter for Western India visited those of Surat, Rajkot, Malegaon and the voluntary observatory at Baroda, and I inspected those of Jacobabad and Hyderabad.

The Kurrachee Observatory was found to be in admirable condition, everything being clean and in good repair, and the work of observation appeared to be equally satisfactory.

The Surat Observatory is stated to be in a good position for registering the temperature, but too much surrounded by large trees to afford good indications of the wind. The instruments were in good order, except that the barometer had become somewhat be dimmed in the course of years. The observer read all the instruments accurately.

The Baroda Observatory has only recently begun to contribute registers, and little can be said of its work.

Rajkot was inspected in November last. It has not been a satisfactory observatory for some time past, which is explained by the fact that the man appointed as observer got into debt, and eventually ran away to escape from his creditors. His successor is said to have had but little training, and his work was far from satisfactory. He was dismissed at the end of the year under report. It appears from Mr. Chambers's report that the observatory stood in much need of inspection.

The observer at Malegaon is said to be painstaking but inexperienced, and in several respects his practice was faulty, and the instruments improperly dealt with. The majority of the instruments were, however, in good order.

The Jacobabad Observatory was found to be in very good order, and the registers apparently accurate and neatly kept.

At Hyderabad the observatory was removed in June 1885 from the European military hospital to the jail—a site offering in some respects a much better exposure. A new observer took over the duties in January, a short time before the observatory was inspected, and though intelligent and painstaking, he had been but imperfectly trained. Some of the instruments, especially the hygrometers and the anemometer, were not in good order, and the barometer was suspended in a bad light.

Of the remaining observatories in Bombay little is said in Mr. Chambers's report. The Beckley's anemographs at Belgaum and Deesa are said to have worked well throughout the year, and the Casella's anemograph at Poona has been in nearly continuous action, but that at Ratnagiri has been less satisfactory. The work of the majority of the observers has been trustworthy, but Hyderabad (under the former observer), Rajkot and Malegaon are exceptions to this rule.

The following special allowances have been awarded for the present year to Observers in the Bombay Presidency :—

Names.	Observatory.	Amount. R
Mahadev Cuddum	Ratnagiri	10
Ramkrishna K. Karandikar	Deesa	5
Narayan Sakaram	Poona	5
G. W. M. D'Aranjo	Karwar	5
Ramchundra Datta	Belgaum	5
Mingue Fernandez	Kurrachee	5
Shaik Ali	Jacobabad	5

OBSERVATORIES IN MADRAS, MYSORE AND HYDERABAD.—Of the 21 observatories in these provinces enumerated in the list on page 17, all but five, *viz.*, the Madras Observatory and those of Gopalpore, Vizagapatam, Coconada and Calicut, are under the control of Miss Pogson as Meteorological Reporter to the Government of Madras. Twelve of the sixteen have been inspected during the year, *viz.*, eight by Miss Pogson and four by myself.

Bellary, a 2nd class station, was visited by Miss Pogson in October 1885. The observatory had been moved to a new site on the 24th April, and the thermometer shed

was therefore nearly new. The instruments were generally in good condition, except that the mercury in the barometer had become slightly oxidized, and all were clean and properly set up. The work is stated to be accurately and carefully performed, but is somewhat tardily sent in.

Trichinopoly, also a 2nd class station, was inspected by Miss Pogson in March 1886. The condition of the observatory was found to be highly satisfactory and most creditable to the Superintendent and Observer. The wind records are temporarily interrupted during the renewal of the staging for the anemometer.

Bangalore was inspected by myself in February 1886, and the chief instruments verified. Everything was found to be in excellent condition, but the barometer had rather a large error, over and above that originally determined. The observer read his instruments correctly, and the registers were neatly kept and brought up to date. As it is probable that the removal of the observatory will soon be absolutely necessary, a site close by was selected, which will involve the least possible disturbance of the existing local conditions.

Coimbatore was inspected by Miss Pogson in August 1885. In June this had been reduced to the same scale as the 3rd class observatories in Northern India, &c., the work and remuneration of the observer both being reduced on the appointment of a new man as observer. The thermometer shed was found to require repair, and the anemometer post and ladder required renewal; in general the instruments were in a satisfactory condition, but the barometer cistern required cleaning, and the wet-bulb thermometer was slightly encrusted. The work of the observer is well reported of.

Cuddapah was inspected by myself in March 1886, and had also been visited by Miss Pogson in October 1885. The instruments were carefully kept, but on verification, the barometer error was found to be larger than that previously determined, and the maximum thermometer had ceased to be self-registering. The sun thermometer also had a portion of the column separated which had not been allowed for. There is no anemometer, and the wind observations are of doubtful value. Also the observer was disregarding the instructions to take his observations according to local time. A staging for the anemometer and wind-vane is now being provided.

The Kurnool Observatory was removed to a better position in the compound of the Collectorate in July 1885, and one of the Collector's clerks appointed observer.

Madura, like Coimbatore, has been reduced to the status of an ordinary 3rd class station, a new observer being appointed after a previous training at Madras. Miss Pogson inspected the observatory in March 1886, and found it and the instruments in a most disgraceful condition of dirt and neglect. The observer seemed to have profited but little by his training, and was performing his work in a most negligent manner.

Mangalore was visited by myself in February 1886, this being the first time that it has been inspected since its establishment. The barometer and thermometers were re-verified, and the former found to have a large unsuspected error. The instruments were well cared for, but the anemometer and wind-vane were not in a good position, and much obstructed, and the thermometer for nocturnal radiation was not in working order.

Masulipatam has been very unsatisfactory, owing apparently to the apathy and negligence of the observer, who had nevertheless been trained at Madras. It has not been inspected, but the registers are full of self-evident inaccuracies, and in other respects the observer has failed to follow the official instructions.

Mercara was visited by myself in February, and the instruments re-verified. Here also a considerable further correction was required to the barometer. The instruments were in creditable condition in general, but the exposure of the wind-vane and anemometer is bad, and the latter was very dirty. The rain-gauge had no internal receiver. The observatory is in course of removal to a site at the dispensary, offering many advantages over the present site at the Electric Telegraph Office.

Negapatam was inspected by Miss Pogson in March 1886, and found to be in very good condition, except that some of the thermometers were improperly suspended. The work of the observer is also well spoken of.

Salem was inspected, also by Miss Pogson, in August 1885. She reports that the general condition of the observatory reflects great credit upon the Superintendent and Observer.

And finally Wellington was inspected in the same month, and everything found to be in good condition, except that the barometer was suspended in a badly-lighted room, used also for other purposes, not quite compatible with the safety of the instrument.

The remaining observatories have not been inspected during the year, but are considered to be working satisfactorily.

A special allowance has been granted to :—

Name.	Observatory.	Amount. R
C. S. Saminatha Pillai	Coimbatore	5

OBSERVATORIES IN BURMA.—As in the previous year, these are eight in number, including Akyab, which is under the administration of the Meteorological Reporter for Bengal, and Diamond Island, which is under the Central Office. The remainder are under the Sanitary Commissioner for Burma.

The six observatories have all been inspected by the Sanitary Commissioner. Some of them twice or oftener, but not by any officer of the Meteorological Department during the past year. The Rangoon Observatory, which, as a 2nd class observatory, ought to set an example to the province, is the subject of the single disparaging remark in the report, and this observatory has never been equal to most of those of its class. There has been an appreciable improvement in several of the 3rd class observatories, more especially Bassein, Toungoo and Thyetmyo, and special allowances for the present year have been awarded to the following Observers :—

Names.	Observatory.	Amounts. R
T. H. Hilbert	Moulmein	5
Maung Pe	Bassein	5
Shaik Hydiat Ally	Toungoo	5

Mr. Pedler reports a considerable improvement in the Akyab registers, which have been punctually submitted.

OBSERVATORIES AT THE BAY ISLANDS.—These observatories have worked satisfactorily, but no special report has been received on their working and condition. Mr. Peters, who has long acted as Observer at Port Blair, in a most satisfactory manner, left in November last, and has been succeeded by Mr. Carroll. There has been a succession of Observers at Nancowry—a state of things by no means conducive to the satisfactory performance of the work, but apparently unavoidable at this unhealthy station. They are enumerated in Appendix C.

EXTRA INDIAN OBSERVATORIES.—There are now but six of these, since the observatories of the Seychelles and Zanzibar ceased to contribute registers. Another, Aden, has now become somewhat irregular, and several months have elapsed since any register was received. The Leh Observatory has been in admirable working order up to October last, when the Actinometric Observer Sergeant Rowland and his Assistant quitted Leh. Since that time, it appears, difficulties have arisen, and it has recently been reported that, if the work is to be carried on satisfactorily, it will be necessary to send a trained man to Leh as observer. There is, and always must be, great difficulty in keeping an observatory in good working order, on the present system of small allowances, unless the position is one readily accessible to inspection.

The Observatory at Bushire has on the whole worked fairly, but recently some of the observations have been less trustworthy.

The work of the Katmandu Observatory has been resumed in full.

The Observatory at Quetta was inspected, for the first time since its establishment, by myself in January last. It was found to be in admirable order, and the observer, an intelligent and painstaking native of Madras, was performing his work in a manner which left nothing to be desired. This satisfactory state of things is entirely due to the careful supervision of Dr. Fullerton, the Residency Surgeon, who has long been in charge of the observatory.

The Amini Divi Observatory was re-established in May, when the Medical Officer, who is also observer, returned to the station. Since that time the registers have been regularly sent in. It is as yet premature to pronounce on the character of the work.

INSTRUMENTS.

In Appendix D is given a return of the instruments in store at the beginning of the year, and of those received and issued by the Calcutta Meteorological Office, and includes the stock, receipts, and issues of the Alipore Observatory; and in Appendix E is a return of the instruments issued to each observatory. In this are incorporated the returns furnished by the local Reporters.

METEOROLOGICAL OFFICERS AND OFFICE WORK.

The general administration of the meteorological observatories and offices in the different provinces, with the local exceptions noticed in the foregoing sections, has been in the hands of the following officers during the year:—

Name.	Office.	Province.
H. F. Blanford, F.R.S. . . .	Meteorological Reporter to the Government of India	Central Office.
W. L. Dallas, Esq. . . .	Assistant Meteorological Reporter to the Government of India.	
Lala Ruchi Ram Sahni, M.A. . .	2nd Assistant Meteorological Reporter to the Government of India	
A. Pedler, Esq. (Offg.) . . .	Meteorological Reporter to the Government of Bengal.	Bengal and Assam.
S. A. Hill, B. Sc. . . .	Meteorological Reporter to the Government of the North-Western Provinces and Oudh.	N.-W. Provinces, Oudh, Rajputana, and Central India (part.)
Dr. E. Lawrie	Meteorological Reporter to the Government of the Punjab.	Punjab.
J. C. Oman, Esq. . . .		
W. L. Dallas, Esq. . . .		

Name.	Office.	Province.
F. Chambers, Esq. . . .	Meteorological Reporter for Western India . .	Bombay, Berar, Rajputana and Central India, (part.)
Miss Isis Pogson	Meteorological Reporter to the Government of Madras.	Madras, Mysore, Coorg, and Hyderabad.
Dr. J. H. Loch	Sanitary Commissioner, Central Provinces . .	Central Provinces.
Dr. C. Little	Sanitary Commissioner, Berar	Berar.
Dr. D. Sinclair	Sanitary Commissioner, Burma	Burma.
Surgeon-Major W. N. Keefer	Senior Medical Officer, Bay Settlements . .	Andamans and Nicobars.

With the exception of the Punjab and also of Bengal, where, during Mr. J. Eliot's absence on furlough, Mr. A. Pedler has continued to officiate as Meteorological Reporter, the local Reporter's duties have all been performed by the permanent incumbents of the several offices.

In the Punjab, Dr. Lawrie resigned the office of Meteorological Reporter to the Punjab Government on quitting the province in April 1885. After his departure, the office was temporarily held by Mr. Oman of the Punjab Educational Department, who remained in charge until the 1st December. On that date he was relieved by Mr. W. L. Dallas, 1st Assistant to the Meteorological Reporter to the Government of India, who undertook the duties in addition to those of his previous office (a part of which, however, had been meanwhile transferred to the 2nd Assistant Lala Ruchi Ram Sahni.)

Mr. Dallas was absent on privilege leave from the 31st March to the 28th June 1885.

The 2nd Assistant Lalla Ruchi Ram Sahni, M.A., was appointed to that office on the 1st June 1885, after a probationary course in the department. He has since continued to prepare the daily weather reports and the daily weather charts, and during Mr. Dallas's absence from Simla, when inspecting observatories in the cold weather, he was left in independent charge of the Simla office.

The following table shows the number of stations, the registers of which were sent to each of the Reporters, respectively, for reduction and verification during the year under report :—

PROVINCES.	METEOROLOGICAL REPORTERS.						TOTAL.
	India.	Bengal.	North-Western Provinces and Oudh.	Punjab.	Western India.	Madras.	
Bengal and Assam	4	20	...	...	...	...	24
North-Western Provinces and Oudh .	1	...	14	...	...	...	15
Punjab	2	...	...	11	...	...	13
Rajputana and Central India . . .	1	...	4	...	4	...	9
Central Provinces	11	...	...	...	...	...	11
Berar	1	...	...	...	4	...	5
Bombay . . . . .	...	...	...	...	13	...	13
Madras, Mysore and Coorg	1	1	...	...	...	16	18
Burma	7	1	...	...	...	...	8
Bay Islands	2	...	...	...	...	...	2
Extra Indian	5	...	...	...	...	1	6
TOTAL	35	22	18	11	21	17	124

This list does not include the registers of the provincial observatories in Bengal, nor those of Colaba Observatory, Madras, Goa and of Jeypore, which are furnished to the Meteorological Office with all the necessary reductions.

In Bengal, the North-Western Provinces and Bombay (in part) the Reporters superintend the rainfall registers of the district and sub-divisional stations of their respective provinces and prepare weekly and monthly returns of the rainfall.

In Bengal the number of rainfall stations has been increased by 72 during the past year. New rules for registering the rainfall have been drawn up and translated into the native languages, and statistics have been collected respecting the kind of gauges in use at sub-divisional stations, their position, &c., and the proximity of objects likely to interfere with the accuracy of the record. By this means certain cases have been brought to light, in which the exposure of the instrument was decidedly faulty, and these have been remedied.

The number of rainfall stations dealt with by each of the above officers is as follow :—

	Stations.
Bengal	244
North-Western Provinces and Oudh	253
Bombay	477

In the Punjab, the superintendence and collection of rainfall registers are not at present in the hands of the Meteorological Reporter, but Mr. Dallas reports that the subject is under the consideration of the local Government.

In Madras also, it has been proposed to transfer the charge of the rainfall registration to the Meteorological Reporter for the province, but this has not yet been carried out.

The Reporters for Bengal and Western India administer a system of storm warnings for the protection of the local ports. In the case of the former, this duty has hitherto been restricted to the port of Calcutta, signals being exhibited at certain stations on the Hooghly estuary, more especially for warning vessels about to put to sea. Lately, as has been already noticed in Part I of this report, the system has been extended so as to comprehend all the principal ports of the Bay of Bengal.

The meteorological observations copied from the log-books of ships entering the port of Calcutta are now received and tabulated in the Central Office, Calcutta.

Mr. Dallas having been relieved of the work of preparing the daily weather report and chart, now discharges the duties of the Meteorological Reporter for the Punjab. He has continued the reduction and preparation for publication of the marine observations relating to the North Indian Ocean and the Bay of Bengal, received in 1877 and 1880 from the London Meteorological Office. The barometric wind and current charts, with a descriptive text, are now being printed, and will be shortly issued; and considerable progress has been made with the corresponding series for the Arabian Sea.

OFFICE ESTABLISHMENTS.—The following is a return of the numbers of ministerial officers and menials in the offices of the several Meteorological Reporters :—

	INDIA.		Bengal.	North-Western Provinces.	Punjab.	Western India.	Madras.	TOTAL.
	Calcutta.	Simla.						
Head Clerks . . .	1	...	1	1	1	1	1	6
Computers . . .	3	...	...	...	...	...	...	3
Clerks and copyists . .	5	...	2	1	3	...	4	15
Tabulators . . .	14 ¹	6	9	4	...	8	...	41
Draughtsmen . . .	2 ²	1	1	...	...	...	...	4
Artisans . . .	...	...	3	...	...	...	...	3
Peons and menials . .	7	5	5	2	2	2	2	25

In December last, Government sanctioned a scheme, submitted in the early part of the year under report, for improving the pecuniary prospects of certain of the ministerial officers, and for placing them on a more equal footing; and also for strengthening the Central Office and those of the Punjab, Western India and Madras Reporters. The net increase of expenditure, thus incurred, amounted to ₹4,000 per annum, and a further sum of ₹5,963 was provided by savings on the salary of the Punjab Reportership (after providing for the salary of the 2nd Assistant above mentioned) and also on the travelling expenses and special Simla allowances previously incurred for the portion of the Central Office previously transferred annually to Simla and back again.

Babu Fanindra Mohun Basu has continued in charge of the Central Office in Calcutta with the same excellent results as in previous years, and I have had much satisfaction in obtaining for him the increase to his salary included in the above scheme. The Head Computer, Babu Nirduksha Kumar Ghosh, has also worked with great intelligence and zeal, and well merits the increase of his salary, which, in common with the other computers, he has recently obtained.

Mr. Pedler (Bengal) reports that his office has worked exceedingly well under the able superintendence of Babu Chandi Charan Chatterjee, and Mr. Hill (North-Western Provinces and Oudh) reports generally that the clerks and tabulators have all worked steadily and well during the year, under the Head Clerk Babu Chintamony Ghosh. Of the establishment of the Madras Office, Miss Pogson reports that each assistant has worked accurately and diligently throughout the year.

WEATHER BULLETINS AND STORM-SIGNAL SERVICE.—Since the 8th April 1885, the daily weather reports issued under the authority of the Department of Revenue and Agriculture, have been drawn up at Simla, a permanent establishment being retained there for the purpose. The reports are issued in the same form as in the previous year. The verbal summary, which accompanies each issue, is telegraphed to all the Provincial Governments, and copies are furnished to the daily newspapers at Calcutta, Allahabad and Bombay,

¹ Besides these, there are three temporary clerks for reducing the London Meteorological Office marine logs.

² Besides these, there is one temporary draughtsman for drawing up the marine charts.

295 copies of the printed report are issued daily to Government officers and one to a subscriber.

As a part of the work connected with the daily reports, notice is sent by urgent telegram to the Meteorological Office, Bombay, of the progress of any storms that advance from the Bay of Bengal towards the Western Presidency ; and notice by urgent telegram is sent to the Civil and Political Officers of Khandesh and Guzerat of the appearance of storms likely to produce floods in the Tapti and Nerbuda ; arrangements have been made also for telegraphing direct to the same officers, from certain observatories in the upper drainage basins of these rivers, the occurrence of heavy rain, in order to give them due warning of probable floods.

In Bengal, the Daily Weather Report for the province was issued from the 20th April to the 7th November, and the Bay of Bengal Weather Report illustrated by a chart, throughout the year. The latter was issued to 39 Government officers and 22 subscribers, the former to 99 Government officers and 19 subscribers.

The storm signals were hoisted on three occasions during the year, *viz.*, for the False Point cyclone of the 22nd September, for a storm which reached the Sunderbuns on the 14th and 15th October, and for that of the 14th to the 23rd November. This storm was formed off the coast of Ceylon and tracked, day by day, in the Bengal Weather charts, as it moved up the Bay, finally crossing the Arakan coast south of Chittagong and breaking up among the Arakan hills. There has been no previous instance of a storm being followed up the Bay with such precision, and indeed it is a rare case that any storm follows so long a course, at so leisurely a rate of progress, and in such a direction (north-east) as this.

At stations on the Bombay coast, the signals were hoisted only on one occasion during the year, *viz.*, for the little storm of the 8th to 10th June, which appears to have originated in the south of the Peninsula, and not as has usually been the case, on the Bay of Bengal. It was very small and the barometric disturbance slight.

WEEKLY, MONTHLY AND SEMI-ANNUAL REPORTS.—From May to October, a descriptive summary of the weather is prepared monthly ; during the rest of the year every alternate month ; and published in the *Gazette*. Reports on the winter and spring snow-fall were also drawn up in May and June, and a forecast of the character of the rains was attempted, which has been noticed at length in Part I of this report.

Charts of the rainfall for the three seasons, into which the year has been divided for this purpose (the cold season, the hot season, and the rains) have been prepared for 1885 from the rainfall registers received by post, and several copies furnished to Government, but these are not published. A general chart and tabular return of the rainfall of the year was also prepared for the Secretary of State.

In Bengal, weekly and monthly Meteorological and Rainfall Reports, for the province, are published in the *Calcutta Gazette*, and sets of 3 rainfall charts, showing the actual distribution of the rainfall and its variation from the average, 1st, in absolute measurement and 2nd as a percentage of the normal average, are prepared monthly for Government. A general summary of the weather of the monsoon and the distribution of the rains, in Bengal, was also drawn up for the Government of Bengal.

In the North-Western Provinces and Bombay, monthly abstracts of the registers of the several observatories are published in the local *Gazettes*, and in the Punjab, since the

beginning of 1886, a descriptive summary of the weather of the province has been prepared for Government and published in like manner.

ANNUAL REPORTS.—The report on the meteorology of the year 1884 was complete and in the printer's hands by the beginning of December 1885, and the printed report submitted to Government on the 23rd March 1886.

The report gives tables of temperature for 138 stations, and rainfall returns for 478 stations, being an increase of four of the former and sixteen of the latter on the numbers respectively given in the report for 1883. The returns of most other meteorological elements are nearly as numerous as those of temperature. The elements tabulated in the Appendix are as follow. For comparison I give the corresponding number for the four previous years :—

	NUMBER OF STATIONS.				
	1880.	1881.	1882.	1883.	1884.
Equilibrium temperature of solar radiation	109	106	112	111	113
Duration of bright sunshine . . . . .	...	...	...	2	3
Temperatures of nocturnal radiation	108	106	104	107	106
Temperatures of the ground	2	4	4	4	4
Mean and extreme air temperatures	126	131	130	134	138
Sea-level equivalents of mean temperatures	105	108	108	111	112
Means and extremes of atmospheric pressure	122	251	124	125	127
Sea-level equivalents of mean atmospheric pressure	105	107	108	109	110
Direction and movement of winds	124	127	125	127	128
Temperature of evaporation	115	121	120	124	128
Tension of atmospheric vapour	123	128	127	130	135
Mean relative humidity	123	128	127	130	135
Mean proportion of clouded sky	122	125	124	127	130
Inches of rainfall in each month	399	417	457	462	478
Number of days on which rainfall was measured	379	403	457	462	474

The descriptive letter-press discusses the chief characteristics of the meteorology of the year. It includes tables of the average values of all the more important meteorological elements, for all stations that have furnished returns for three years and upwards, and the report is illustrated with four plates, *viz.*, a chart showing the position of all observatories and rain-gauge stations, and three in coloured lithography, representing the mean distribution of temperature, pressure, and winds in each month of the year.

The original observations of six observatories, *viz.*, Calcutta, Lucknow, Lahore, Nagpur, Bombay and Madras, were issued in a distinct publication in monthly parts. Those forming the volume for 1885 were completed in June 1886.

The Reporters for Bengal, the North-Western Provinces, the Punjab, and Bombay, each prepared and submitted to the local Governments, summaries of the weather features of the year 1884 in their respective provinces.

MISCELLANEOUS PUBLICATIONS.—Parts IV and V of Volume II of the Indian Meteorological Memoirs were issued during the year, completing the second volume of the work. The first, already referred to in last year's report, contains a very important and elaborate discussion of the characters and tracks of all the storms of the Bay of Bengal, that have been recorded on the office charts, during the months May to December, in the five years 1877 to 1881. The second contains a short Memoir of Mr. Hill's on the variations of the temperature and humidity of the atmosphere at 4 and 40 feet above the ground surface at Alipore. Also the title page, lists of contents and general index to the volume.

Part I of Volume III was issued just before the close of the year, containing the first part of a Memoir on the rainfall of India, which, when complete, with its tables, will occupy the whole volume. Three other Memoirs, *viz.*, one by Mr. Eliot on the Akyab cyclone of the 12th to 17th May 1884, one by myself on the diurnal variation of the rainfall of Calcutta, and one by Mr. Dallas on the meteorology of a sea tract to the south of the Bay of Bengal, were printed and nearly ready for issue at the close of the year, forming Part I of Volume IV.

Other Memoirs are in course of preparation by Mr. Hill, Mr. Pedler and myself. Mr. Chambers, on the plea of want of sufficient office assistance, has contributed nothing to the official publications of the department since the list of storms drawn up in 1882, and published in Part I, Volume II of the Memoirs.

Appendix F, gives a list of the Government officials, libraries, observatories, societies, &c., to which the publications of the office are presented, including those which send their own publications in exchange.

LIBRARY.

The additions to the library during the past year are enumerated in Appendix G, under 215 titles. The library remains, as last year, in ten double book-cases in a large room on the ground floor of the office building. It is in good order, but it has not been practicable to undertake its re-arrangement, no officer having been available for the purpose.

HENRY F. BLANFORD,

Meteorological Reporter to the Government of India.

SIMLA :

The 28th July 1886.

APPENDIX A.

Extract from the Administration Report of the Meteorological Reporter to the Government of Bengal.

* * * * *

Both the second class observatories were visited during the year. *Dhubri* was inspected by myself on 19th March 1886. Generally speaking, I was far from satisfied with the condition of the observatory. The Casella's anemograph was, so far as [regards] direction, working with considerable friction, and the pointer was showing south-south-west, but in reality the wind was east-north-east. It showed a great want of observation on the part of the observer to record and report a wind direction almost diametrically opposite to the actual direction. The thermometers were dirty and covered with cobwebs. The bulbs of the wet instruments were found to be slightly encrusted, and the compound of the observatory was considerably overgrown with jungle. The solar radiation thermometer had a separation of mercury at the top of the tube of almost exactly 4°. The observer stated that he made allowance for the break, and that he had reported the fact to the head office, but the statement could not be verified from the office records either at the observatory or at the head office. The rain-gauge receiver was found to hold only 1·38 inches of rain, and the observer stated that if the reservoir overflowed, he mopped up the excess water with a cloth and squeezed out the water into the measuring glass. The rain-gauge was therefore changed for a 5-inch gauge with a proper receiver. The anemometer was in very bad order with the cups dented, and the instrument was erected in a most disgraceful manner. A new anemometer has been supplied. The observer and his assistant do not appear to understand their work properly. The observer's knowledge of English is very limited, and he is not in my opinion competent for the post of senior observer, though he might perhaps have previously done his work as assistant overseer properly. A new head observer will have to be appointed after a man is thoroughly trained in the Alipore Observatory. By my visit to the station, my former convictions of the carelessness of the observer were fully confirmed. In July 1885, I had occasion to fine the head observer Kadimuddin Ahmed Rs. 5, and his assistant his allowance for nine days, for neglect of duty in missing the hourly observations on several days, but the fines scarcely seem to have had the desired effect.

Saugor Island was visited by my head clerk on the 12th January 1886. It was the first visit of inspection since the thermometer shed was erected and the Beckley's anemograph put up in position in 1880. The sites for the shed and the anemograph were selected by Mr. Eliot on his visit to the station in March 1878. The thermometer shed is of the standard pattern and is erected within the grounds of the telegraph office, and enclosed by a nulla and a mound of earth at a distance as a protection from inundation. The telegraph office building stands directly to the south or south-east of the shed at a distance of 38 feet from it. There are several trees very near to the shed, which have the effect of making the place very close and shady. The barometer is placed against the wall near the doorway leading into the signal room. It was originally placed in a wooden shed of the old telegraph office, and within the light-house compound, but the instrument has been in its present position since February 1880, in a good light, and at a height of 25·3 feet above the mean sea-level. A Fortin's instrument is in use, and it was found to be in good working order. The thermometers were found in good order.

The sun thermometer continues to be exposed on forked sticks at a height of 6 inches from the ground, as the same instrument has been in use since 1876. The Regulation stand has not been brought into use here. The rain-gauge in use was of old pattern, and 6 inches in diameter. The float of the gauge was lost, and the measurement of rainfall was made by means of a corresponding measure-glass. It was situated on the embankment, towards the south of the telegraph building. A new 5-inch rain-gauge has since been supplied and brought into use. The Beckley's anemograph is set up on the top of the watch tower of the telegraph office, and the cups of the anemometer are 51 feet above the ground. There are no objects near, higher than the building. The instrument

appeared to be set correctly, and its bearings were found well oiled. The condition of the observatory in charge of Mr. Peters, telegraph master, who has been for a long time connected with the Department, was highly satisfactory.

During the observership of Mr. Thomas, telegraph master, the grass minimum thermometer readings were found to be very low. An enquiry was made into the matter, and the result showed the defect in the readings was due to a break in the spirit column of the instrument, which was not noticed by the observer for months together. Mr. Thomas was therefore fined ₹15 in August 1885 for this gross carelessness. The grass readings for 18 months had to be rejected.

Eight of the 3rd class observatories were inspected during the year, *viz.*, Gya, Bankipore, Hazaribagh, Dacca, Darjeeling, Durbhunga, Jessore and Purneah.

Purneah was visited by my head clerk on 23rd June. He reported that the observatory shed had been removed to a new site, near the jail compound, by order of Mr. Eliot, owing to the erection of a building for the jailor's quarters close to the old site, but the conditions of exposure were almost identical with those of the abandoned site. The shed was in good order and the instruments clean and in working order, with the exception of the minimum thermometer, which had its column separated. The anemometer has become much shut in by the gradual growth of a row of high trees, that stand to the east and north-east of the instrument, at a distance of 60 yards. The average height of the trees is now 50 to 60 feet, while the anemometer is at a height of 25 or 26 feet above the ground. The medical officer (Dr. Picachy), in charge of the observatory, has been asked to select a more suitable site for the anemometer.

Darjeeling was visited on 16th November. As previously stated, the object of the inspection was to put the Beckley's anemograph in working order, as it had not worked for nearly two months, and the observer had not been able to put it right. The instrument was rendered effective. The other instruments were in good order, except the minimum thermometer, the column of which had slightly separated. The mercury in the cistern of the barometer was also cleaned, and the instrument put in good order. Mr. R. Carter, Rector, St. Paul's School, who is the Superintendent of the observatory, continues to take much interest in the observatory.

Bankipore was visited on 27th November by myself. The condition of the observatory was fairly satisfactory. Munshi Mohabat Lal, who has been the observer for some time, having been suspended from his appointment as head clerk, Temple Medical School, a brother clerk, who has had experience in meteorological work, has been temporarily put in charge of the observations. A higher rate of allowance had been sanctioned for the station by the recent arrangements in consideration of the fact that Munshi Mohabat Lal would reduce the observations himself and submit completed returns; but if the Munshi is not reinstated, and a new man is permanently appointed, the meteorological allowance will have to be reduced to ₹15, as at other third class stations, and the work of reduction and tabulation will be done in the central office.

Gya was visited on 16th December by Mr. Blanford, Meteorological Reporter to the Government of India. Mr. Blanford carefully verified the thermometers and the barometer in use, and the corrections of some of the thermometers were found to have altered. These instruments have therefore been recalled for re-verification. The worthlessness of the minimum readings at Gya was noticed in the previous administration reports. The real cause of this anomaly has been found to be that, since the introduction of the Bengal Daily Weather Report in 1883, the readings of the wet minimum thermometer have been reported to this office in the 10 A.M. telegrams instead of those of the dry minimum. The observer (Nowringee Lal) had been given ample opportunity to find out the cause of the erroneous minimum readings reported daily, but he failed to do so and the fact is fatal to his character as an observer. He was consequently fined two months' pay last year, and again a month's allowance (₹15) in July 1885 for his continued inattention to the instructions he had received. The observer (Nowringee Lal) has gone on leave for six months, and advantage has been taken of this to appoint Mukund Lal, who had undergone practical training at the Bankipore observatory, to the observership.

Jessore was visited by my head clerk on 27th December. There has been no change in the site or exposure of the instruments, but there had been a very decided change for the worse in the observer, and most of the instruments were in bad order, and the observer's excuses for the state of the observatory were most paltry. In consequence the observer's special allowance has been suspended for six months.

Dacca observatory was visited by my head clerk on 20th January 1886. The barometer has been removed since 3rd May 1884 to the present position in the signal room of the telegraph office. It is now at an elevation of 21·7 feet above mean sea-level. The mercury in the cistern of the barometer was cleaned. The minimum thermometer had been out of order since November, and the observer had been unable to put it right, but the spirit column was easily restored. The anemometer was much in want of oil, and the observer neglected to take in the sun thermometer every night. The observatory was therefore not in very satisfactory order.

Hazaribagh was inspected on 27th March. The condition of the observatory was very satisfactory. All the instruments were found to be in perfectly good order. The point of greatest importance in the inspection was to solve certain discrepancies in the wind records of the Casella's anemograph. It was found that the principle on which the observer had worked hitherto was to make the embossed arrows on the paper correspond to the actual direction of the pointer of the wind-vane or to the absolute direction of the wind, and thus the N. embossed arrow on the paper made a very considerable angle with the line of the paper. The instrument was re-set, and the observer instructed how to keep the instrument in the required order. The observer was recommended for the continuance of the special allowance of Rs 5 he had hitherto drawn.

Durbhunga observatory was inspected on 30th March. All the instruments were in perfectly good working order and the shed in excellent repair. The observer, Baboo Jogin Chunder Banerjee was the recipient of a five-rupee special allowance in 1883-84, but it was withdrawn for bad work. The observer was well reported on in 1884-85, and the condition of the observatory continuing to be equally good during 1885-86, he was restored to the special allowance for the ensuing year.

The remaining observatories of this class, *viz.*, Sibsagar, Cuttack, Chittagong, Berhampore, Silchar, Demagiri, False Point, Akyab, Tura, Tezapore and Burdwan, could not be visited during the year; but from the returns received, it may be presumed that their efficiency has been maintained in the majority of cases.

Sibsagar.—Baboo Dandadhar Dutt Barua has continued to do good work during the year, and the special allowance of Rs 10 has therefore been continued to him during the ensuing year.

Cuttack.—Mr. Alley, telegraph master, was in charge throughout the year. The observations have been satisfactory and the returns punctual. He has been and is still the recipient of a five-rupee special allowance for meritorious services.

Chittagong.—The telegraph master in charge, Mr. Gabriel, has done his work well, and has been in charge of the observatory during the whole of the year. There were very few mistakes in the observations.

Berhampore.—The returns have been regular and satisfactory. Baboo Mahendra Nath Roy continues to be the observer. His special allowance of Rs 10 has therefore been continued to him.

Silchar.—Mr. Blanford, Meteorological Reporter to the Government of India, visited this station early in 1884, and found that the shed was not built according to the standard plan. The observatory has hitherto been a most costly one, requiring yearly repairs, averaging Rs 100. This was due to the shed being much larger than was necessary, and to the sole use of wood in its construction, which was rapidly destroyed by the attacks of white-ants. Mr. Blanford therefore sanctioned the erection of a more durable shed of standard dimensions supported on iron pillars. This has since been completed. The observer has submitted fairly satisfactory returns.

Demagiri.—This station has not been visited since it was started. The only instruments in use are a dry bulb and a maximum, a dry minimum thermometer and a wind-vane. The wind-vane was blown down by a storm and injured. The maximum and minimum thermometer readings have not been satisfactory. The civil hospital assistant of the Police Dispensary was in charge of the readings under the supervision of the civil medical officer. There is no allowance attached to this station, as it was established by the Deputy Commissioner of Chittagong Hill Tracts under the provisions of the rules for volunteer observers. The observations from this station are so far from satisfactory that they are frequently rejected.

False Point.—The observatory shed was blown down by the storm of September 23rd, which passed over this station and swept away Hookitola, which was also a rainfall-recording station. A very valuable set of observations was made at this station during the cyclone of this date by Mr. Workman, the observer. The telegraphic communication remained suspended from the 22nd

September 1885 to 6th January 1886, when the 10 A.M. telegrams were again resumed. The shed instruments were all saved by their timely removal, but the anemometer was blown down and badly injured. This has since been replaced by a new instrument. The records for the year were fairly satisfactory. Mr. Workman, light-house keeper, was formerly the observer on an allowance of ₹25 a month, but he having been appointed Port Officer, False Point, Mr. London succeeded to the post of meteorological observer on the reduced allowance of ₹20, and the observations are now being taken by him.

Akyab.—The registers have improved much. They were punctually received in this office.

Burdwan.—The observatory is apparently in excellent order, and the returns from this station have been satisfactory. Baboo Mokshoda Prasad Roy Chowdhury has well maintained his reputation, and has been recommended for the continuance of his special allowance of ₹10.

Tura.—The registers from this station have been of very doubtful value.

* * * * *

ALEX. PEDLER,

*Offg. Meteorological Reporter to the
Government of Bengal.*

METEOROLOGICAL OFFICE, BENGAL;

The 5th June 1886.

APPENDIX B.

Extract from the Administration Report of the Meteorological Reporter to the Government of the North-Western Provinces and Oudh.

The first class observatory at Allahabad obtained its full equipment in the beginning of March, and the full staff of observers has been entertained only since the 1st April. The new building in the Chatham lines, for the observatory in conjunction with the Meteorological Office, was not quite completed at the end of the year under report, but was already so far advanced in November that it could be occupied by the office. Very little progress was made during the cold weather, and it was not until the beginning of March that the arrangements for setting up the meteorograph were completed.

* * * * *

Whilst the building was being got ready, the series of comparative thermometer readings at the old and new observatory sites, commenced in September 1884, was carried on; but from the 1st December only two complete sets of readings have been made at the old site instead of four as formerly, whereas at the new observatory four sets of observations have been made instead of two. On the removal of the office and the accompanying transformation of the new observatory into the principal one, the hour of the early morning observation was changed from 4 to 6 A.M., the latter being more convenient to the observers and more nearly coincident with the epoch of minimum temperature. It is, moreover, the hour adopted at the Alipore Observatory, Calcutta.

A summary of the comparative observations of temperature and humidity for the year under report is given in the Appendices. The series will be continued until the end of August, when a period of two years will be completed. The twelve months' observations in the Appendix show that the mean temperature at the new site is higher than at the old by about half a degree, and that the difference is greatest at the end of the rains, whilst at the hottest time of the year the old site is slightly hotter than the new. The minimum temperatures do not differ much in any month, nor do the maxima, except in the hot-weather months, when they are about a degree lower at the new site than at the old. The excess of the mean at the new site is due to the higher temperature of the forenoons and afternoons, as indicated by the observations made at 10 A.M. and 4 P.M.

These differences are all explained by the circumstances that the new site is on an open breezy plain, covered in the rainy season with grass cropped short by grazing cattle, whilst the old site is in

a hollow surrounded by trees, and in the rains and for some time afterwards, covered with long grass and other vegetation. The trees cut off the morning and afternoon sun, but not the mid-day sun; and as the air does not circulate so freely as at the new site, a higher temperature is attained at the hottest time of the day, in those months when the wind velocity is highest. In the months at the end of the rains, when there is little or no wind, the maximum temperatures would probably be equal were it not that the old site is rendered slightly cooler by the vegetation and consequent evaporation. At this season also, the foliage of the trees is densest and cuts off the morning and afternoon sun most completely.

The humidity observations, on the whole, bear out this explanation, but during the three months of the dry hot weather, there was apparently a slight excess of humidity at the new site, not easily explicable.

The nocturnal radiation thermometer gave uniformly lower indications at the new site than at the old, as was to be expected. The differences of the solar radiation thermometers are so great and irregular that they are only explicable on the assumption that the two instruments (which are supposed to be corrected to a common standard) are not comparable, except when exposed side by side under absolutely identical conditions. That a very slight change of position alters the indications of these instruments, owing to a change in the quantity of heat they receive from surrounding objects, has been recently and unexpectedly rendered evident, by the inadvertent vitiation of the long series of observations made with the instrument in use at the old site, which has fortunately escaped breakage since January 1876. In 1884, the position of this instrument was changed, to make room for the tower mentioned in last year's report—a change which I did not discover until this year. The instrument was placed 3 or 4 yards nearer to a small mango tree, the result being a permanent rise of its indications empirically determined to be about 2° Fahrenheit. As the long series of observations at the old site has thus been interrupted, and the observations were certain to be discontinued at the end of August, the instrument has now been removed to the new observatory, where it will again be compared with the one in use there.

* * * * * * * *

Since the removal of the Meteorological Office and the observatory head-quarters to the new building last November, the hourly observations kept up, as at the second class stations, for nearly ten years, have been abandoned. The observations, now made, comprise a full set of pressure, temperature, humidity, wind, rain, cloud, and general weather observations five times daily, besides the continuous registration of the first five of these elements by the Van Rysselberghe meteorograph; also observations of ground temperature, and of the temperature and humidity in the thermograph penthouse and in a similar penthouse near the top of the tower three times a day, these latter being made with a view to determine the variation of temperature and humidity with height above the ground; and, in addition to all the above, observations of special instruments, such as the sunshine recorder, the nephoscope, and Frankland's solar thermometer.

S. A. HILL,

*Meteorological Reporter to the Government,
North-Western Provinces and Oudh.*

Comparison of shade temperatures at the New Observatory, Chatham Lines, Allahabad, with those simultaneously recorded at the old site.

MONTH.		MEAN TEMPERATURE.*			MEAN AT 10 A.M.			MEAN AT 4 P.M.			MEAN MAXIMA.			MEAN MINIMA.			MEAN DAILY RANGE.		
		Differ- ence.		New.	Differ- ence.		New.	Differ- ence.		New.	Differ- ence.		Old.	Differ- ence.		New.	Differ- ence.		Old.
		Old.	New.		Old.	New.		Old.	New.		Old.	New.		Old.	New.		Old.	New.	
April	1885	86.1	85.9	+0.2	92.0	92.9	-0.9	99.3	99.0	+0.3	101.1	102.0	-0.9	71.6	+0.3	29.2	30.4	-1.2	
May	"	88.6	88.7	-0.1	93.9	94.8	-0.9	101.1	100.9	+0.2	102.5	103.8	-1.3	74.9	-0.1	27.6	28.8	-1.2	
June	"	92.0	92.6	-0.6	95.1	95.7	-0.6	100.0	100.2	-0.2	102.2	103.4	-1.2	82.9	-0.1	19.4	20.4	-1.0	
July	"	84.4	84.3	+0.1	85.7	85.7	0.0	89.0	88.4	+0.6	90.8	91.0	-0.2	79.1	-0.2	11.7	11.7	0	
August	"	81.6	81.3	+0.3	83.4	83.1	+0.3	84.7	84.2	+0.5	87.1	87.4	-0.3	77.8	+0.2	9.3	9.8	-0.5	
September	"	83.0	82.4	+0.6	87.0	86.4	+0.6	90.0	88.7	+1.3	92.0	92.0	0	76.1	+0.3	15.9	16.2	-0.3	
October	"	78.2	76.9	+1.3	84.8	82.9	+1.9	91.5	88.2	+3.3	92.6	91.8	+0.8	66.4	+0.1	26.2	25.5	+0.7	
November	"	68.3	66.7	+1.6	77.6	74.0	+3.6	83.8	80.2	+3.6	84.7	84.3	+0.4	54.0	-0.1	30.7	30.2	+0.5	
December	"	59.8	59.1	+0.7	63.9	62.6	+1.3	69.9	68.6	+1.3	71.4	70.9	+0.5	50.2	-0.6	21.2	20.1	+1.1	
January	1886	59.9	59.1	+0.8	64.6	62.5	+2.1	72.4	70.9	+1.5	73.6	73.0	+0.6	48.1	-0.2	25.6	24.7	+0.9	
February	"	62.9	62.5	+0.4	67.3	66.2	+1.1	77.8	77.1	+0.7	78.6	78.9	-0.3	49.4	-0.1	29.2	29.5	-0.3	
March	"	76.1	75.4	+0.7	81.5	80.7	+0.8	88.8	88.3	+0.5	90.3	91.0	-0.7	63.0	+0.6	27.3	28.6	-1.3	
YEAR		76.7	76.2	+0.5	81.4	80.6	+0.8	87.4	86.3	+1.1	88.9	89.1	-0.2	66.1	0	22.8	23.0	-0.2	

* Computed by means of variable corrections proportional to the range, from the 10 A.M., 4 P.M., maximum and minimum observations.

*Comparison of the readings of the radiation thermometers taken at the Old and New
Observatories, Allahabad.*

MONTH.	SUN RADIATION THERMOMETER.			NOCTURNAL RADIATION THERMOMETER.		
	New.	Old.	Difference.	New.	Old.	Difference.
April 1885	162.1	162.3	—0.2	60.3	62.0	—1.7
May "	163.7	163.6	+0.1	64.2	66.8	—2.6
June "	162.5	160.9	+1.6	76.5	77.8	—1.3
July "	149.4	145.3	+4.1	77.0	77.4	—0.4
August "	146.4	140.2	+6.2	76.1	76.2	—0.1
September "	153.0	152.2	+0.8	71.9	71.9	0
October "	152.4	152.3	+0.1	57.8	58.8	—1.0
November "	143.8	146.4	—2.6	43.6	45.0	—1.4
December "	124.2	125.3	—1.1	41.4	43.4	—2.0
January 1886	133.4	135.4	—2.0	37.8	39.6	—1.8
February "	144.1	140.9	+3.2	37.8	40.3	—2.5
March "	156.3	152.6	+3.7	52.5	55.0	—2.5
YEAR	149.3	148.1	+1.2	58.1	59.5	—1.4

Comparative observations of atmospheric humidity at the Old and New Observatories, Allahabad.

MONTH.	VAPOUR TENSION IN INCHES OF MERCURY.						RELATIVE HUMIDITY OR PERCENTAGE OF SATURATION.					
	MEAN.			At 10 A.M.			MEAN.			At 10 A.M.		
	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.
April 1885 . . . . .	.388*	.373*	+0.015	.411	.384	+0.027	.33*	.32*	+1	28	26	+2
May " . . . . .	.488	.458	+0.030	.509	.477	+0.032	39	37	+2	34	31	+3
June " . . . . .	.747	.722	+0.025	.756	.736	+0.020	53	51	+2	49	47	+2
July " . . . . .	.944	.974	—0.030	.970	.999	—0.029	79	83	—4	79	81	—2
August " . . . . .	.932	.954	—0.022	.941	.967	—0.026	86	88	—2	82	85	—3
September " . . . . .	.851	.871	—0.020	.893	.904	—0.011	74	77	—3	70	72	—2
October " . . . . .	.559	.615	—0.056	.601	.620	—0.019	57	64	—7	50	55	—5
November " . . . . .	.375	.398	—0.023	.405	.392	+0.013	54	60	—6	45	47	—2
December " . . . . .	.376	.389	—0.013	.394	.392	+0.002	72	75	—3	67	69	—2
January 1886 . . . . .	.351	.359	—0.008	.380	.366	+0.014	66	70	—4	62	64	—2
February " . . . . .	.256	.308	—0.052	.264	.294	—0.030	45	54	—9	39	45	—6
March " . . . . .	.428	.454	—0.026	.455	.481	—0.026	49	53	—4	43	46	—3
YEAR . . . . .	.558	.573	—0.015	.582	.584	—0.002	59	62	—3	54	56	—2

* Crude mean of 10 A.M. and 4 P.M. and minimum observations.

APPENDIX C.

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India, during the year 1885-86.

PROVINCE.	Observatory.	Class.	Names of Superintendents.	PERIOD.		Names of Observers.	PERIOD.	
				From	To		From	To
BENGAL AND ASSAM.	Sibsagar . . .	Third . . .	Civil Surgeon . . .	1st April 1885	31st Mar. 1886	Dandadhar Dutt, Burua . . .	1st April 1885	31st Mar. 1886.
	Dhubri . . .	Second . . .	Dr. Edwin Dobson . . .	1st April 1885	31st Mar. 1886	{ Munshi Kadimuddin Ahmed . . . Ambica Prosad Dey (Assistant) . . . Munshi Kafayat Ulla (Do.) . . .	1st April 1885 26th April 1885 1st April 1885	31st Mar. 1886. 16th April 1885. 31st Mar. 1886.
	Silchar . . .	Third . . .	Civil Surgeon . . .	1st April 1885	31st Mar. 1886	Romesh Chandra Bhadra . . .	1st April 1885	31st Mar. 1886.
	Tezapore . . .	Ditto . . .	Ditto . . .	2nd April 1885	31st Mar. 1886	{ Joggeswar Dass . . . Narayan Chandra Basu . . . Shufet Hossain . . .	{ 2nd April 1885 19th Mar. 1886 6th Jan. 1886	6th Nov. 1885. 31st Mar. 1886. 18th Mar. 1886.
	Patna . . .	Ditto . . .	Ditto . . .	1st April 1885	31st Mar. 1886	Munshi Mohabat Lall . . .	1st April 1885	31st Mar. 1886.
	Hazaribagh . . .	Ditto . . .	Ditto . . .	1st April 1885	31st Mar. 1886	{ Surjan Singh . . . Nuthoo Lall . . .	1st April 1885 28th Jan. 1886	27th Jan. 1886. 31st Mar. 1886.
	Saugor Island . . .	Second . . .	.....	.....	.....	Mr. J. A. Thomas . . . " W. Cahill . . . " R. H. Peters . . . " H. W. Alley . . . " J. E. Gabriel . . . " W. Moore . . .	1st April 1885 1st April 1885 18th Sept. 1885 15th Nov. 1885 1st April 1885 1st April 1885	31st Mar. 1886. 17th Sept. 1885. 14th Nov. 1885. 31st Mar. 1886. 31st Mar. 1886. 31st Mar. 1886.
	Cuttack . . .	Third . . .	.....	.....	.....	{ Rajoni Kanta Chuckerbutty . . . Matilal Roy . . . Lalit Mohun Banerjee . . .	1st April 1885 1st April 1885 18th July 1885	31st Mar. 1886. 17th July 1885. 27th Dec. 1885.
	Chittagong . . .	Ditto . . .	.....	.....	.....	{ Latit Mohun Banerjee . . . Jogin Chunder Banerjee . . . Nowringee Lall . . . Mukund Lall . . .	28th Dec. 1885 1st April 1885 1st April 1885 1st Jan. 1886	31st Mar. 1886. 31st Mar. 1886. 31st Dec. 1885. 31st Mar. 1886.
	Darjeeling . . .	Ditto . . .	Rector, St. Paul's School . . .	1st April 1885	31st Mar. 1886		1st April 1885	31st Mar. 1886.
	Purneah . . .	Ditto . . .	Civil Medical Officer . . .	1st April 1885	31st Mar. 1886		1st April 1885	31st Mar. 1886.
	Durbhanga . . .	Ditto . . .	Civil Surgeon . . .	1st April 1885	31st Mar. 1886		1st April 1885	31st Mar. 1886.
	Gya . . .	Ditto . . .	Ditto . . .	1st April 1885	31st Mar. 1886		1st April 1885	31st Mar. 1886.

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India, during the year 1885-86—continued.

PROVINCE.	Observatory.	Class.	Names of Superintendents.	PERIOD		Names of Observers.	PERIOD	
				From	To		From	To
BENGAL AND ASSAM— <i>concl.</i>	Berhampore .	Third	Civil Surgeon .	1st April 1885	31st Mar. 1886	Mohendra Nath Roy .	1st April 1885	31st Mar. 1886.
	Burdwan .	Ditto	Ditto .	1st April 1885	31st Mar. 1886	Mokhoda Prasad Chowdhury .	1st April 1885	31st Mar. 1886.
	Jessore .	Ditto	Ditto .	1st April 1885	31st Mar. 1886	Parash Nath Roy Chowdhury .	1st April 1885	31st Mar. 1886.
	Dacca .	Ditto	.....	.....	.....	Mr. T. W. DeSouza .	1st April 1885	31st Mar. 1886.
	False Point .	Ditto	.....	.....	.....	{ Mr. E. Workman .	1st April 1885	23rd Sept. 1885.
			.....			{ „ J. London .	24th Sept. 1885	31st Mar. 1886.
	Damagiri .	Fourth	Civil Medical Officer .	1st April 1885	31st Mar. 1886	{ Grish Chundra Bhar .	1st April 1885	18th April 1885.
	Mongpoo .	Ditto	.....	.....	.....	{ Rajany Kanta Bose .	26th May 1885	31st Mar. 1886.
	Tura .	Ditto	Civil Medical Officer .	1st April 1885	31st Mar. 1886	{ Mr. George A. Gammie .	19th April 1885	25th May 1885.
	Pedong .	Third	.....	.....	.....	{ Mr. Abdul Majeem .	1st April 1885	31st Mar. 1886.
N.-W. PROVINCES AND OUDH.						{ Revd. Father A. Disgodins, S.J. .	1st April 1885	22nd Mar. 1886.
						{ „ „ Hervagault, S.J. .	23rd Mar. 1886	31st Mar. 1886.
						{ Kedar Nath Chatterjee .	1st April 1885	31st Mar. 1886.
						{ Sostibhusan Banerjee (Asst.) .	1st April 1885	31st May 1885.
	Allahabad .	First	S. A. Hill, Esq., B.Sc. .	1st April 1885	31st Mar. 1886	{ Nand Lal (Asst.) .	1st June 1885	30th June 1885.
						{ Makham Lal Mukerjee (Asst.) .	1st July 1885	31st July 1885.
						{ Nand Lal (Asst.) .	1st Aug. 1885	31st Dec. 1885.
						{ Sostibhusan Banerjee (Asst.) .	1st Jan. 1886	31st Mar. 1886.
	Agra .	Third	{ Dr. A. H. Hilson .	1st April 1885	27th Aug. 1885	{ Mir Altaf Ali .	1st April 1885	31st Mar. 1886.
			{ „ W. Moir .	28th Aug. 1885	26th Feb. 1886	{ Abdul Mejid Khan (Asst.) .	1st April 1885	31st Dec. 1885.
			{ „ A. H. Hilson .	27th Feb. 1886	31st Mar. 1886			
	Lucknow .	Ditto	{ „ J. C. Whishaw .	1st April 1885	15th Feb. 1886			
			{ „ J. Sykes .	16th Feb. 1886	5th Mar. 1886			
			{ „ J. Cleghorn .	6th Mar. 1886	31st Mar. 1886			
			{ Capt. Harrison, R.E. .	1st April 1885	30th June 1885			
	Roorkee .	Ditto	{ Dr. Murray Thomsen .	1st July 1885	31st Mar. 1886			

CENTRAL INCES.	Jubbulpore	Brigade Surgeon W. R. Rice, M.D.	1st April 1885	10th May 1885	Sadhuram Dubey	1st April 1885	31st Mar. 1886.
		Surgeon-Major R. T. Wright M.D.	11th May 1885	6th July 1885	Ramlogan Singh (Asst.)	1st April 1885	31st Mar. 1886.
	Pachmarhi	Brigade Surgeon W. R. Rice, M.D.	7th July 1885	31st Mar. 1886	Pandit Krishna Rao	1st April 1885	28th Feb. 1886.
		Surgeon-Major R. Drury	1st April 1885	31st Mar. 1886	T. M. Venkatachalem Pillay	1st Mar. 1886	31st Mar. 1886.
	Saugor	W. H. Booth	1st April 1885	13th Nov. 1885	T. M. Venkatachalem Pillay (Asst.)	1st April 1885	28th Feb. 1886.
		J. B. Gaffney	14th Nov. 1885	31st Mar. 1886	P. Raja Ruthnum (Asst.)	1st Mar. 1886	31st Mar. 1886.
	Hoshangabad	Surgeon C. Henderson	1st April 1885	31st March 1886	Narain Rao	1st April 1885	24th Feb. 1886.
		Surgeon-Major J. B. Gaffney	1st April 1885	31st Aug. 1885	Jadunath Bose	25th Feb. 1886	31st Mar. 1886.
	Seoni	H. K. McKay	1st Sept. 1885	31st Mar. 1886	Jadunath Bose	1st April 1885	24th Feb. 1886.
		P. Cullen	1st April 1885	25th May 1885	Narain Rao	23th Feb. 1886	9th Mar. 1886.
BERAR.	Khandwa	G. R. Daphary, M.D.	1st April 1885	31st Aug. 1885	Govind Vithal	10th Mar. 1886	31st Mar. 1886.
		Surgeon S. H. Browne, M. D.	19th Aug. 1885	31st Mar. 1886	Punchum	1st April 1885	31st Mar. 1886.
	Chanda	Assistant Surgeon Shibchunder Bhat- tercharjee	1st April 1885	22nd Nov. 1885	Beharilal Parasar	1st April 1885	31st March 1886.
		Surgeon-Major B. Evers, M.D.	23rd Nov. 1885	31st Mar. 1886	Seetaram	1st April 1885	31st March 1886.
	Sironcha	Narahar Govind, Tahsildar	1st April 1885	31st March 1886	Moothu Krishna Naidoo	1st April 1885	31st March 1886.
		Brigade Surgeon D. W. Trinnell	1st April 1885	31st Mar. 1886	Krishna Rao	1st April 1885	18th June 1885.
	Raipur	Surgeon J. L. Poynder	1st April 1885	23th Oct. 1885	Mr. Aggis	19th June 1885	20th Aug. 1885.
		Pedroza	30th Oct. 1885	31st Dec. 1885	Govind Ramchundra	21st Aug. 1885	31st Mar. 1886.
	Sambalpur	J. L. Poynder	1st Jan. 1886	31st Mar. 1886	Syed Mahomed Hyder Hassani Hydri	1st April 1885	8th Oct. 1885.
		Surgeon J. J. Moran	1st April 1885	31st Mar. 1886	Annanth Ram Behara	9th Oct. 1885	31st Mar. 1886.
BERAR.	Akola	Apothecary Dr. Callaghan	1st April 1885	31st Mar. 1886	Samuel Gregory	1st April 1885	31st Mar. 1886.
					Huseni Beg	1st April 1885	31st May 1885.
	Buldana				Shanker Ramrao	1st June 1885	31st July 1885.
					Abdul Karim	1st Aug. 1885	4th Sept. 1885.
					Luxmon Vinayek	5th Sept. 1885	14th Nov. 1885.
					Waman Pandurang	15th Nov. 1885	31st Mar. 1886.

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India, during the year 1885-86.—continued.

PROVINCE.	Observatory.	Class.	Names of Superintendents.	PERIOD		Names of Observers.	PERIOD	
				From	To		From	To
BERAR—concl'd.	Chikalda	Third	{ Surgeon R. James Assistant Apothecary W. Hendricks Surgeon R. James Assistant Apothecary W. Hendricks	1st April 1885	17th June 1885	Hiralal	1st April 1885	31st March 1886.
	Amraoti	Ditto	{ Surgeon T. Hume " R. B. Roe " T. Hume	1st April 1885	16th April 1885	Bukaram Pandurang	1st April 1885	31st Mar. 1886.
	Makhlā	Fourth	J. Balantine	17th April 1885	13th July 1885	Papannah	1st April 1885	31st Mar. 1886.
	Jeypur	First	Surgeon-Major T. H. Hendley	14th July 1885	31st Mar. 1886	Durga Pershad	1st April 1885	31st Mar. 1886.
	Sutna	Third	" S. J. Goldsmith	1st April 1885	31st Mar. 1886	Nathu Narayan	1st April 1885	31st Mar. 1886.
	Nowgong	Ditto	John Mather, Esq.	1st April 1885	31st Mar. 1886	Sheo Pertab	1st April 1885	31st Mar. 1886.
	Neemuch	Ditto	Surgeon-Major E. C. R. Ward	1st April 1885	15th July 1885	Pandit Harnath	1st April 1885	31st Mar. 1886.
			Surgeon C. E. Nichol	16th July 1885	7th Sept. 1885	Baldeva Parshad	1st April 1885	31st Mar. 1886.
			" S. J. Flood	8th Sept. 1885	15th Oct. 1885	T. Bachu	1st April 1885	7th Feb. 1886.
			" C. Nichol	16th Oct. 1885	15th Nov. 1885	Ramji Khandriji	8th Feb. 1886	23rd Feb. 1886.
CENTRAL INDIA AND RAJPUTANA.			Surgeon-Major F. Falvasser	16th Nov. 1885	31st Jan. 1886	T. Bachu	24th Feb. 1886	31st Mar. 1886.
			Surgeon J. Lucas	1st Feby. 1886	8th Mar. 1886			
			" D. V. O'Connell	9th Mar. 1886	31st Mar. 1886			
			Surgeon-Major D. F. Keegan	1st April 1885	11th Aug. 1885			
	Indore	Ditto	" R. Caldecott	12th Aug. 1885	9th Nov. 1885	Trimbakrao	1st April 1885	31st Mar. 1886.
			" D. F. Keegan	10th Nov. 1885	27th Mar. 1886			
			" R. Caldecott	28th Mar. 1886	31st Mar. 1886			
	Mount Abu	Ditto	Surgeon-Major R. H. Robinson	1st April 1885	31st Dec. 1885	S. K. Gadgil	1st April 1885	1st May 1885.
			Assistant Apothecary J. W. Ranger	1st Jan. 1886	31st Mar. 1886	M. M. Talati	25th July 1885	31st Mar. 1886.

Pachpadra	Ditto	G. A. Bradford	1st April 1885	31st Mar. 1886	{ Murat Lall P. Halder G. C. Banerji P. Halder Ram Parshad Muhammed Habibulla Khan Ram Lall Luchmandas Ram Chandra Datta Shantaram Wassudev (Asst.) Balaji Krishna (Asst.) Narayan S. Kelkar C. S. Moodliar (Asst.) Krishnaji Narain G. C. Moodliar	1st April 1885 19th Oct. 1885 13th Feb. 1886 25th Feb. 1886 1st April 1885 1st April 1885 22nd May 1885 1st April 1885 1st April 1885 10th April 1885 1st April 1885 1st April 1885 30th Oct. 1885 1st Mar. 1886	18th Oct. 1885 12th Feb. 1886 24th Feb. 1886 31st Mar. 1886 31st Mar. 1886 31st Mar. 1886 21st May 1885 31st Mar. 1886 31st Mar. 1886 7th April 1885 31st Mar. 1886 31st Mar. 1886 23rd Oct. 1885 28th Feb. 1886 31st Mar. 1886
Ajmere	Ditto	Surgeon-Major J. H. Newman, M.D.	1st April 1885	31st Mar. 1886			
Sambar	Ditto	F. Ashton, Esq.	1st April 1885	31st Mar. 1886			
Bickaneer	Ditto	.....	.....	.....
Belgaum	Second	{ Surgeon-Major W. J. Campbell " R. P. Ferguson	1st April 1885 1st May 1885	30th April 1885 31st Mar. 1886			
Yarrowda (Poona)	Ditto	" S. M. Solomon	1st April 1885	31st Mar. 1886			
Deesa	Ditto	{ " W. P. Bridges Surgeon C. B. Maitland. Surgeon-Major W. P. Bridges Surgeon C. B. Maitland. Surgeon-Major W. P. Bridges Surgeon A. S. Falkner Surgeon-Major W. P. Bridges	1st April 1885 2nd April 1885 18th April 1885 1st May 1885 31st May 1885 20th Nov. 1885 19th Dec. 1885	1st April 1885 17th April 1885 30th April 1885 30th May 1885 19th Nov. 1885 18th Dec. 1885 31st Mar. 1886	Ramkrishna Keshav Doyal Bhala (Asst.)	1st April 1885 1st April 1885 31st Mar. 1886 31st Mar. 1886	
Kurrachee	Ditto	Brigade Surgeon C. H Girard	1st April 1885	31st Mar. 1886	{ Minguel Fernandez Hassan Kadar (Asst.)	1st April 1885 1st April 1885	31st Mar. 1886 31st Mar. 1886
Jacobabad	Third	{ Surgeon B. N. Koyaji " A. Milve " H. Adey	1st April 1885 31st Dec. 1885 1st Mar. 1886	30th Dec. 1885 28th Feb. 1886 31st Mar. 1886	Sheikh Ali	1st April 1885	31st Mar. 1886
Hyderabad (Sind)	Ditto	{ Surgeon-Major R. M. Craig Surgeon H. Adey Surgeon-Major H. De Fatham	1st April 1885 1st June 1885 19th June 1885	31st May 1885 18th June 1885 31st Mar. 1886	S. Pais Mahmed Yubiff Kison Sing Hussan Khan Shankerji Naronji	1st April 1885 1st June 1885 14th Jan. 1886 22nd Jan. 1886 1st April 1885	31st May 1885 13th Jan. 1886 21st Jan. 1886 31st Mar. 1886 31st Mar. 1886
Bhuj	Ditto	" F. Jones	1st April 1885	31st Mar. 1886			

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India, during the year 1885-86—continued.

PROVINCE.	Observatory.	Class.	Names of Superintendents.	PERIOD		Names of Observers.	PERIOD	
				From	To		From	To
BOMBAY—concl.	Rajkot . . .	Third	{ Surgeon-Major S. B. Haliday Surgeon J. Wilkins . . .	1st April 1885	31st Jan. 1886	Hurry Sing Ruttan Sing . . .	1st April 1885	30th Mar. 1886.
	Sholapur . . .	Ditto	{ W. R. Scroggie, Esq., L.R.C.P. Surgeon-Major H.A. Lewis . . . " S. O. B. Banks . . . " H. Atkins . . . " S. O. B. Banks . . .	1st Feb. 1886 1st April 1885 1st April 1885 28th April 1885 16th June 1885 17th June 1885	31st Mar. 1886	Balwant Laxman . . .	1st April 1885	31st Mar. 1886.
	Surat . . .	Ditto	{ Asstt. Surgeon Dassabhoj Pestanji. Surgeon-Major S. O. B. Banks . . . (No Superintendent . . .	26th June 1885 1st Oct. 1885 1st Jan. 1886	30th Sept. 1885 31st Dec. 1885 31st Mar. 1886	Chhagan Lal Huri Lal . . .	1st April 1885	31st Mar. 1886.
	Malegaon . . .	Ditto	{ Surgeon A. F. Ferguson . . . No Superintendent . . .	1st April 1885 15th April 1885	14th April 1885 11th June 1885	Shaikh Mohamed . . .	1st April 1885	31st Mar. 1886.
	Ratnagiri . . .	Ditto	{ Surgeon H. McColman . . . (R. G. C. Westbrook, Esq. . .	12th June 1885 1st April 1885	31st Mar. 1886 31st Mar. 1886	Mahadev Cuddum . . .	1st April 1885	31st Mar. 1886.
	Karwar . . .	Ditto	{ A. R. Maidment, Esq. . . R. G. C. Westbrook, Esq. . .	1st April 1885 5th Jan. 1886	4th Jan. 1886 7th Mar. 1886	G. W. M. D'Aranjo . . .	1st April 1885	31st Mar. 1886.
	Bellary . . .	Second	{ Surgeon-Major H. M. G. Archdall . Surgeon H. Thompson, M.B. . . Surgeon-Major T. J. H. Wilkins . . . Asst. Surgeon W. D. Bartley . . . Surgeon T. H. Pope, M.B. . .	1st April 1885 10th June 1885 25th June 1885 6th Nov. 1885 1st Dec. 1885	9th June 1885 24th June 1885 5th Nov. 1885 30th Nov. 1885 31st Mar. 1886	B. G. Sashachellum Naidu . . . P. Namasiroyam Pillay . . . B. G. Sashachellum Naidu . . . Sreenivasa Row, (Asstt.) . . . T. Lutchman Row . . .	1st April 1885 14th July 1885 14th Aug. 1885 1st April 1885 1st April 1885	13th July 1885. 13th Aug. 1885. 31st Mar. 1886. 31st Mar. 1886.
	Trichinopoly . . .	Ditto	{ Surgeon-Major L. C. Nanney, M.D. " H. Hyde . . .	1st April 1885 6th Aug. 1885	5th Aug. 1885 31st Mar. 1886	E. M. Bhojarajulu Naidu (Asstt.) . . . E. R. Sathoo Row (Asstt.) . . .	1st April 1885 23rd April 1885	31st Mar. 1886. 31st Dec. 1885.
	Gopalpore . . .	Third	Port Officer . . .	1st April 1885	31st Mar. 1886	G. Appalanarasimham . . . J. Suneasi Row . . .	1st April 1885 1st Jan. 1886	31st Mar. 1886.

Masulipatam	Ditto	Surgeon-Major J. B. Thomas, L. R. C.P.L.	1st April 1885	31st Mar. 1886	{ Uma Ranganayakulu Naidu M. C. Lutchmeepathy Naidu	1st April 1885	30th June 1885.
Secunderabad	Ditto	{ Surgeon-Major G. F. Bevan " T. C. H. Spencer	1st April 1885 18th June 1885	17th June 1885 31st Mar. 1886	{ J. T. Williams G. R. Paramaswara Iyer	1st April 1885 1st April 1885	31st Mar. 1886. 31st Mar. 1886.
Kurnool	Ditto	{ E. C. Johnson, Esq., C.S. S. H. Wynne, Esq., B.A., C.S.	1st April 1885 16th Mar. 1886	15th Mar. 1886 31st Mar. 1886	{ G. Narayanaswamy Naidu S. V. Varadarajulu Naidu	1st June 1885 9th July 1885	31st May 1885. 8th July 1885. 31st Mar. 1886.
Cuddapah	Ditto	{ Surgeon M. Iyasawmy Asst. Surgeon C. P. Ganapati, L.M.S.	1st April 1885 4th Jan. 1886	3rd Jan. 1886 15th Feb. 1886	{ V. A. Vijiravulu Moodeliar	1st April 1885	31st Mar. 1886.
Bangalore	Ditto	{ Surgeon M. Iyasawmy Surgeon-Major A. F. Dobson, M.B.	15th Feb. 1886 1st April 1885	31st Mar. 1886 31st March 1886	Rungaswamy Moodeliar	1st April 1885	31st March 1886.
Negapatam	Ditto	{ Surgeon H. St. C. Caruthers Surgeon-Major A. H. Leapingwell Surgeon T. H. Pope, M.B. 3rd class Hospital Assistant M. Stronivasa Naidu.	1st April 1885 23rd June 1885 28th Oct. 1885 14th Nov. 1885	28th June 1885 27th Oct. 1885 13th Nov. 1885 19th Nov. 1885	{ S. Saminatha Iyer	1st April 1885	31st March 1886.
Salem	Ditto	{ 1st grade Assistant Apothecary H. A. Henderson. Surgeon J. Kernan " W. F. Thomas Assistant Surgeon M. Thummen Singh, M. B.	28th Nov. 1885 1st April 1885 27th Oct. 1885 16th Nov. 1885	31st March 1886 26th Oct. 1885 15th Nov. 1885 31st March 1886	{ L. Ramsing	1st April 1885	31st March 1886.
Coimbatore	Ditto	{ Surgeon S. C. Sarkies Surgeon-Major J. F. Fitzpatrick, M.D.	1st April 1885 4th June 1885	3rd June 1885 31st March 1886	{ Varadia Naidu C. S. Saminatha Pillay N. E. Kangayan Pillay	1st April 1885 1st June 1885 1st April 1885	31st May 1885. 31st March 1886. 30th April 1885.
Madura	Ditto	Surgeon F. C. Smith	1st April 1885	31st March 1886	{ V. Sashachellum Naidu G. R. Paramaswara Iyer	1st May 1885 1st June 1885	31st May 1885. 31st March 1886.
Calicut	Ditto	Captain F. M. Gillham	1st April 1885	31st March 1886	F. D'Rozario	1st April 1885	31st March 1886.
Cochin	Ditto	{ Brigade Surgeon W. H. Morgan 2nd grade Apothecary O. W. Jones, M.D.	1st April 1885 1st Nov. 1885	31st Oct. 1885 28th Jan. 1886	{ M. V. Eippe	1st April 1885	31st March 1886.
Wellington	Ditto	{ Brigade Surgeon W. H. Morgan Surgeon-Major W. G. Grant " W. Keir	29th Jan. 1886 1st April 1885 11th Dec. 1885	31st March 1886 10th Dec. 1885 31st March 1886	{ H. Brownsall	1st April 1885	31st March 1886.

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India, during the year 1885-86—concluded.

PROVINCE.	Observatory.	Class.	Names of Superintendents.	PERIOD.		Names of Observers.	PERIOD.	
				From	To		From	To
MADRAS—conclud.	Mercara	Third	Surgeon-Major Mark Robinson	1st Feb. 1886	31st March 1886	T. S. Annachellum Pillay	1st April 1885	22nd July 1885.
	Mangalore	Ditto	.....	.....	.....	A. M. Venkatasiah.	23rd July 1885	31st Dec. 1885.
	Rajahmundry.	Ditto	Surgeon-Major E. Levinge	1st April 1885	31st March 1886	Sivaram Moodeliar.	1st Jan. 1886	31st Jan. 1886.
	Cocanada	Ditto	Port Officer	1st April 1885	31st March 1886	C. Venket Kristnaya	1st Feb. 1886	31st March 1886.
	Rangoon	Second	Surgeon-Major H. Johnstone, M.D.	1st April 1885	31st March 1886	{D. T. D'Souza	1st April 1885	8th Oct. 1885.
	Bassein	Third	Surgeon S. H. Dantra	1st April 1885	31st March 1886	{S. J. Croning	9th Oct. 1885	31st March 1886.
	Diamond Island	Ditto	.....	.....	.....	A. Mukunda Row Naidu	1st April 1885	31st March 1886.
	Akyab	Ditto	.....	.....	.....	C. J. M. Gaetane	1st April 1885	31st March 1886.
	Thayetmyo	Ditto	Surgeon W. P. Dalzell	1st April 1885	25th Sept. 1885	{G. E. Wales	1st April 1885	31st March 1886.
	Mergui	Ditto	Surgeon-Major J. Backhouse, F.R.C.S.	26th Sept. 1885	31st Dec. 1885	{O. White (Asst.)	1st April 1885	31st March 1886.
	Toungthoo	Ditto	Surgeon E. P. Frenchman	1st Jan. 1886	31st March 1886	Moung Pé	1st April 1885	31st March 1886.
	Moulmein	Ditto	{Mr. P. G. Paul	1st April 1885	13th Feb. 1886	F. W. Marsh	1st April 1885	31st March 1886.
			{ „ Robert Hall Nailor	14th Feb. 1886	31st March 1886	{Mr. E. B. Atkinson	1st April 1885	31st Dec. 1885.
BURMA			Surgeon Maurice Smith	1st April 1885	10th Nov. 1885	{ „ M. McSweeney	11th Feb. 1886	31st March 1886.
			Mr. G. B. Fonseca	11th Nov. 1885	9th Dec. 1885	Alladeen	1st April 1885	31st March 1886.
			Surgeon C. S. Rundle	10th Dec. 1885	31st March 1886	Mooasjee	1st April 1885	31st March 1886.
			Brigade Surgeon W. F. DeFaback, M.D.	1st April 1885	22nd Sept. 1885	Shaik Hydiat Ally	1st April 1885	31st March 1886.
			Surgeon R. Ross	23rd Sept. 1885	13th Oct. 1885	T. St. Hilbert	1st April 1885	31st March 1886.
			Surgeon-Major Oswald Baker	14th Oct. 1885	31st March 1886			

APPENDIX D.

Return of the Stock, Receipt and Issue of Instruments for the year 1885-86.

Instruments.	In store on 1st April 1885.	Received, 1885-86.	Issued, 1885-86.
Van Rysseberghe's meteorograph	1	...	1
Barometers, observatory, Fortin's principle	9	10	7
Do. do. Kew principle	6	4	8
Do. mountain, portable tripod (Adie)	20	10	10
Do. marine, Kew principle	21	2	3
Do. Newman's large standard	2	...	...
Do. do. small standard	3	...	...
Do. Negretti and Zambra (various)	7	9	3
Aneroids	18	1	2
Hick's barograph	1	...	...
Thermometers, standard, with attached scales	16	...	7*
Do. do. without attached scales (chemical)	1	...	1
Do. for hygrometers (Kew pattern)	36	14	20
Sling thermometers	7	...	4
Thermometers, maximum, for shade	68	13	26*
Do. solar in vacuo (self-registering)	9	43	35†
Do. do. do. (non-self-registering)	21	...	5
Do. do not in vacuo	2	...	...
Do. minimum, for shade	33	26	31
Do. do. for radiation	14	33	26
Six's thermometers	6	1	...
Traveller's maximum and minimum thermometers . . . . .	...	6	...
Frankland's sun thermometers	3	1	1
Boiling point thermometers	7	...	...
Thermograph, with Negretti and Zambra's sets of recording thermometers	1	...	...
Common thermometers, brass scales	27	...	1
Ponillet's pyrheliometer	1	...	...
Stewart's actinometer (thermometers for)	7	...	...
Do. do. (chamber for)	1	...	...
Hodgkinson's do.	2	...	...

* 1 condemned as unserviceable.
† 2 do. do.

Return of the Stock, Receipt and Issue of Instruments for the year 1885-86—concluded.

Instruments.	In store on 1st April 1885.	Received, 1885-86.	Issued, 1885-86.
Herschell's actionometer	1	...	...
Regnault's hygrometers	3	...	...
Daniell's do.	10	...	...
Halleur's do.	5	...	...
Pocket spectroscopes (Browning's)	2	...	1
Anemometers	18	16	27
Wind-vanes . . . . .	...	21	19
Beckley's anemograph . . . . .	...	1	...
Casella's do. . . . .	...	2	...
Electric anemometer and wind-vanes	3	...	...
Rain-gauges (Symons') 5" diameter	48	10	20
Do. 6" do.	1	...	...
Self-registering rain-gauge (Casella's) . . . . .	...	1	...
Measure-glasses for 5" rain-gauges	8	17	24
Do. do. 6" do.	2	...	...
Reading lenses	2	2	3
Sun thermometer-stands	4	10	3
Radiation pads	2	2	4
Thermometer cages	3	7	6
Do. do. for ships	14	...	1
Prismatic compasses	1	2	2
Magnetic do. . . . .	...	7	7
Sand-glasses (3 minutes)	43	...	26
Sunshine recorders	3	...	2
Bull's-eye lanterns . . . . .	...	1	1
Salinometers	35	1	36
Clocks . . . . .	...	9	9
Spirit-level	1	...	...
Electrophorus	1	...	...
Filled tubes for marine Kew principle barometers	12	...	2
Do. do. observatory, do. do. do.	8	12	1
Do. do. Adie's mountain Fortin barometers . . . . .	...	4	4
Chain for Casella's embossing anemograph	100 ft.	...	100 ft.
Glass cylinder jars	2	...	...

APPENDIX E.

Return of the Instruments issued to each Observatory in 1885-86.

PROVINCE.	STATIONS.	Barometer.	HYGRO-METER.		Dry maximum thermometer.	MINI-MUM THERMO-METER.		RADIATION THERMO-METER.		Anemometer.	Wind-vane.	Rain-gauge.	Measure-glass.	Lens.	Clock.	Sand-glass.	Stand for sun thermometer.	Pad for grass radiation thermometer.	Cages.	Anemograph, Beckley's.	Aneroid.	Standard thermometer.	Sling thermometer.	Bull's-eye lantern.	Actinometer thermometer.	Nephoscope.	Frankland's sun thermometer.	Sunshine recorder.	Salinometer.	Meteorograph.	Spectroscope.	Compass.	Filled tubes for marine K. P. barometer.	Filled tubes for observatory K. P. barometer.	Filled tubes for Adie's mountain Fortin's barometer.	
			Dry.	Wet.		Dry.	Wet.	Solar.	Grass.																											
ARABIA .	Aden . . . . .	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BELUCH-ISTAN.	Quetta . . . . .	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
CASH-MERE.	Leh . . . . .	...	...	...	...	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
NEPAL .	Katmandu	2	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
PUNJAB.	Kailang . . . . .	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mooltan . . . . .	...	1	...	1	1	2	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Dera Ismail Khan . . . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Peshawar . . . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Murree . . . . .	...	...	...	...	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Rawalpindi . . . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sialkot . . . . .	...	1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Lahore . . . . .	...	...	...	1	...	3*	1	...	1	...	2	...	...	...	...	...	...	...	...	5	...	...	...	...	1	...	...	...	...	...	...	...	...	...
	Ludhiana . . . . .	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sirsa . . . . .	...	1	1	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
N.-W. P. AND OUDH.	Chakrata . . . . .	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ranikhet . . . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Pithoragarh . . . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Meerut . . . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bareilly . . . . .	...	...	...	...	...	...	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Agra . . . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Lucknow . . . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Gorakhpur . . . . .	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Allahabad	1	1	2	2	1	1
	Benares . . . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
ASSAM	Ghazipur . . . . .	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Tezpur†	1	1	1	1	1	1	1	1	1	1	1	1	...	...	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Patna . . . . .	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Gya . . . . .	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Hazaribagh . . . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BENGAL.	Burdwan	1	1	1
	Jessore . . . . .	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Chittagong . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Demagiri . . . . .	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Alipore . . . . .	...	1	...	...	...	...	1	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	False Point . . . . .	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...
	Arrah . . . . .	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

* One non-self-registering.
† Original furniture.

Return of the Instruments issued to each Observatory in 1885-86—continued.

PROVINCE.	STATIONS.	Barometer.	HYGRO-METER.		Dry maximum thermometer.	MINI-MUM THERMO-METER.		RADIATION THERMO-METER.		Anemometer.	Wind-vane.	Rain-gauge.	Measure-glass.	Lens.	Clock.	Sand-glass.	Stand for sun thermometer.	Pad for grass radiation thermometer.	Cages.	Anemograph, Beckley's.	Aneroid.	Standard thermometer.	Sling thermometer.	Bull's-eye lantern.	Actinometer thermometer.	Nephoscope.	Frankland's sun thermometer.	Sunshine recorder.	Salinometer.	Meteorograph.	Spectroscope.	Compass.	Filled tubes for marine K. P. barometer.	Filled tubes for observatory K. P. barometer.	Filled tubes for Adie's mountain Fortin's barometer.	
			Dry.	Wet.		Dry.	Wet.	Solar.	Grass.																											
BENGAL.—contd.	Balasore . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bankoora* . . .	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bhagulpore . . .	...	1	...	...	...	...	...	...	1	1	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bogra . . .	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Burrisal . . .	...	...	...	2	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Chupra . . .	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Furcedpore . . .	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Krishnagar* . . .	2	1	1	2	1	...	...	...	1	1	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Maldah* . . .	2	1	1	1	2	...	...	...	1	1	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Midnapore . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mymensingh . . .	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Noakhally . . .	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ranchee . . .	...	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Rungpore . . .	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Serajgunge . . .	...	...	...	...	...	...	...	...	2	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
CENTRAL PROVINCES.	Raipur . . .	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Nagpur . . .	...	...	2	...	...	...	2	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Seoni . . .	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Jubbulpore . . .	...	1	1	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Saugor . . .	...	...	...	...	...	...	2	...	2	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Pachmarhi . . .	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BERAR.	Hoshangabad . . .	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Khandwa . . .	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Chikalda . . .	...	...	...	...	...	...	...	...	...	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Buldana . . .	...	...	1	1	1	1	...	...	1	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
CENTRAL INDIA.	Amraoti	1	1	1
	Akola . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Neemuch . . .	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Indore . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
RAJPUTANA.	Nowgong	1	1
	Sutna . . .	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mount Abu . . .	...	...	...	...	...	...	...	1	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bickaneer . . .	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sambhar . . .	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BOMBAY	Ajmere*	1	1	1	1	1	1	1	1
	Jacobabad . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Hyderabad . . .	1	...	...	...	...	...	...	...	1	1	1	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Kurrachee . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bhuj . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Rajkot . . .	...	...	...	2	...	...	...	...	1	...	...	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

* Original furniture.

Return of the Instruments issued to each Observatory in 1885-86—concluded.

PROVINCE.	STATIONS.	HYGRO-METER.		Dry maximum thermometer.	MINI-MUM THERMO-METER.		RADIATION THERMO-METER.		Anemometer.	Wind-vane.	Rain-gauge.	Measure-glass.	Lens.	Clock.	Sand-glass.	Stand for sun thermometer.	Pad for grass radiation thermometer.	Cages.	Anemograph, Beckley's.	Aneroid.	Standard thermometer.	Sling thermometer.	Bull's-eye lantern.	Actinometer thermometer.	Nephoscope.	Frankland's sun thermometer.	Sunshine recorder.	Salinometer.	Meteorograph.	Spectroscope.	Compass.	Filled tubes for marine K. P. barometer.	Filled tubes for observatory K. P. barometer.	Filled tubes for Adie's mountain Fortin's barometer.
		Barometer.	Dry.		Wet.	Dry.	Wet.	Solar.																											Grass.
BOMBAY—concl'd.	Deesa . . .	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Surat . . .	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Malegaon . . .	...	...	...	...	...	1	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Poona . . .	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sholapur . . .	...	1	...	...	...	1	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ratnagiri . . .	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Karwar . . .	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Gopalpore . . .	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Rajahmundry . . .	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Masulipatam . . .	...	...	...	1	...	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
MADRAS AND MYSORE.	Secunderabad . . .	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Kurnool . . .	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bellary . . .	...	...	...	...	1	1*	1	1	1	1	...	...	...	†1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bangalore . . .	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Cuddapah . . .	2	...	...	1	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Coimbatore . . .	...	...	...	1	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Trichinopoly . . .	...	...	...	...	...	1*	...	1	...	1	...	...	...	†1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Negapatam . . .	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Madura . . .	...	1	...	2	...	1	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Rangoon . . .	...	...	...	...	...	1*	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BURMA	Toungoo . . .	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Moulmein . . .	1	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Diamond Island . . .	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BAY ISLANDS.	Nancowry . . .	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BELUCH-ISTAN.	Pishin . . .	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	F. L. V. "Star" . . .	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Pilot vessel "Guide"† . . .	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	F. L. V. "Meteor" . . .	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Cocos Island† . . .	1	1	1	1	1	1	...	1	1	1	1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Forest Dept., Ajmere . . .	2	2	1	2	2	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	„ „ Madras . . .	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	„ „ Assam . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Afghan Boundary Commission . . .	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	...	...	...	...	...	...	...	...	...	...	...
	Bagelkhand Agency	1	
	Metl. Office, Bengal	10	14	1	
	„ „ Punjab . . .	1	1	
	„ „ Bombay	
	„ „ Simla	
	Mathl. Instt. Departt.	1	1

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* Non-self-registering.
† For ditto.

‡ Original furniture.

APPENDIX F.

List of Recipients of the Publications of the Meteorological Office.

Adelaide	Meteorological Observatory.
Agra	The Editor of the <i>Delhi Gazette</i> .
Ajmere	Chief Commissioner of Ajmere.
Akola	Sanitary Commissioner for Berar.
Algeria	Director of the Meteorological Service of the École des Sciences d'Alger.
	Secretary to the Government, North-Western Provinces and Oudh.
	Department of Revenue and Agriculture, North-Western Provinces and Oudh.
Allahabad	Meteorological Reporter, North-Western Provinces and Oudh.
	Sanitary Commissioner, ditto ditto.
	Editor of the <i>Pioneer</i> .
Amsterdam	Royal Academy of Sciences.
Bangalore	Chief Commissioner, Mysore and Coorg.
	Conservator of Forests, Mysore and Coorg.
Batavia, Java	Meteorological Observatory.
Berlin	Royal Prussian Meteorological Institute.
	Secretary to the Government of Bombay.
	Meteorological Reporter for Western India.
	Colaba Observatory.
	Sanitary Commissioner with the Government of Bombay.
	Bombay University.
Bombay	Asiatic Society of Bombay.
	Sassoon Mechanics' Institute.
	Geographical Society of Bombay.
	Editor of the <i>Bombay Gazette</i> .
	Ditto <i>Times of India</i> .
	Elphinstone College.
Brisbane, Queensland	Observatory.
Brussels	Royal Academy of Sciences.
	Observatoire Royal.
Bucharest, Roumania	Meteorological Institute.
Budapesth	Observatory.
	H. M. Secretary of State for India (through Revenue and Agricultural Department).
	Secretary to the Government of India, Revenue and Agricultural Department.
	Ditto ditto, Home Department.
	Ditto ditto, Public Works Department.
	Ditto ditto, Foreign Department.
	Ditto ditto, Department of Finance and Commerce.
	Ditto ditto, Military Department.
	Private Secretary to His Excellency the Viceroy.
	Secretary to the Government of Bengal, Revenue Department.
	Meteorological Reporter to the Government of Bengal.
	Surveyor General of India.
	Director, Geological Survey of India.
Calcutta	Sanitary Commissioner with the Government of India.
	Ditto ditto ditto Bengal.
	Superintendent, Botanical Gardens, Calcutta.
	Inspector-General of Forests with the Government of India.
	Surgeon-General ditto ditto.
	Asiatic Society of Bengal.
	Indian Museum Library.
	Calcutta University.
	Presidency College.
	Public Library.
	Editor of the <i>Calcutta Review</i> .
	Ditto <i>Statesman and Friend of India</i> .

List of Recipients of the Publications of the Meteorological Office—continued.

	Editor of the <i>Englishman</i> .
	Ditto <i>Indian Daily News</i> .
	Ditto <i>Hindu Patriot</i> .
	Ditto <i>Indian Agriculturist</i> .
Calcutta—concl'd.	St. Xavier's College Observatory.
	The Alipore Observatory.
	Mint Master.
	Indian Association for the Cultivation of Science.
Cambridge	University Library (through H. M.'s Secretary of State for India).
Cambridge, Massachusetts	Harvard University.
Cape of Good Hope	Astronomer Royal.
Carlsruhe, Baden, Germany	Bureau für Meteorologie und Hydrographie.
Chemnitz	Royal Meteorological Institute.
Chatham	Royal Engineers' Library (through Revenue and Agricultural Department).
Christiania	Norske Meteorologiske Institut.
	Royal Observatory.
Colombo	Editor of the <i>Ceylon Times</i> .
	Ditto <i>Ceylon Observer</i> .
	Surveyor General of Ceylon.
Constantinople	Observatoire Impérial Météorologique.
Copenhagen	Danske Meteorologiske Institut.
	Royal Danish Academy of Sciences.
Cordoba	Meteorological Office.
	National Academy of Science.
Darjeeling	Conservator of Forests, Government of Bengal.
Dehra Dun	Editor of the <i>Indian Forester</i> .
	Superintendent, Great Trigonometrical Survey.
Dharwar	Conservator of Forests, Bombay, Southern Division.
Dublin	Royal Dublin Society.
Dacca	Dacca College.
	Scottish Meteorological Society.
Edinburgh	Astronomer Royal for Scotland, Royal Observatory.
	Scottish Geographical Society (through H. M.'s Secretary of State for India).
Ellichpore	Assistant Conservator of Forests, Melghat Division.
Goa	Royal Observatory.
Greenwich	Astronomer Royal, Royal Observatory.
Guatemala	Observatorio Meteorologico del Institut Nacional de Guatemala.
Hamburg	Nord Deutsche Seewarte.
	Deutsche Meteorologische Gessellschaft.
Havana	Real Collegio de Belen.
Hong-Kong	Observatory.
Indore	Agent to the Governor General for Central India in charge of the Residency.
Iowa, U. S.	Iowa Weather Service.
Jeypore	Maharajah's Observatory.
Jubbulpore	Civil Surgeon of Jubbulpore.
Katmandu	Resident at Nepal.
Khandwa	Civil Surgeon of Nimar.
Kitzingen, Bavaria	Dr. Emil Von Schlagintweit.
Kurrachee	Conservator of Forests, Bombay, Sind Division.
	Secretary to the Government of the Punjab.
Lahore	Meteorological Reporter ditto ditto.
	Sanitary Commissioner ditto ditto.
	Conservator of Forests ditto ditto.
	Editor of the <i>Indian Public Opinion</i> .
Leeds	Yorkshire College (through H. M.'s Secretary of State for India).
Lisbon	Observatoire de Infante d'Luiz.
	Academy of Sciences.
	Meteorological Council.
London	Royal Society.
	Royal Asiatic Society (through H. M.'s Secretary of State for India).
	Northbrook Indian Club (through H. M.'s Secretary of State for India).

List of Recipients of the Publications of the Meteorological Office—continued.

London.— <i>concl'd.</i>		Society of Arts.
		Institution of Civil Engineers.
		Royal School of Mines.
		Royal Meteorological Society.
		Admiralty Library.
		United Service Museum.
		British Museum (through H. M.'s Secretary of State for India).
		Athenæum Club.
		Editor of the <i>Philosophical Magazine</i> .
		Ditto <i>Athenæum</i> .
Madras		Ditto <i>Nature</i> .
		Ditto <i>Symons's Monthly Meteorological Magazine</i> .
		Ditto <i>Westminster Review</i> .
		Ditto <i>Quarterly Review</i> .
		Secretary to the Government of Madras.
		Ditto ditto Public Works Department.
		Meteorological Reporter to the Government of Madras.
		Government Astronomer, Madras.
		Sanitary Commissioner, Government of Madras.
		Madras University.
Madrid		Editor of the <i>Madras Times</i> .
		Ditto <i>Madras Mail</i> .
		Superintendent, Government Central Museum.
		Assistant Director of Agriculture, Government of Madras.
		Surgeon General, British Medical Department.
		Ditto, Indian Medical Department.
		Master Attendant of Madras.
		Conservator of Forests, Northern Circle.
		Royal Observatory.
		Observatory of the Magdeburgh Zeitung.
Magdeburgh		Literary and Philosophical Society.
		Meteorological Observatory.
		Meteorological Society.
		Observatory.
		University Library.
		Public Library.
		Central Meteorological Observatory.
		Royal Astronomical Observatory.
		Royal Observatory.
		Royal Bavarian Academy of Sciences.
Manchester		Geographical Society.
		Chief Commissioner, Central Provinces.
		Sanitary Commissioner, ditto.
		Inspector General of Education, Central Provinces.
		Superintendent, Meteorological Observatory.
		Conservator of Forests, Central Provinces.
		Ditto ditto, North-Western Provinces and Oudh.
		Connecticut Academy of Arts and Sciences.
		Editors of the <i>American Journal of Science</i> .
		Central Park Observatory.
Manila		Sub-Divisional Officer.
		Conservator of Forests, Government of Madras.
		Editor of the <i>South of India Observer</i> .
		Radcliffe Library.
		Radcliffe Observatory.
		Observatoire Physique Central de Montsouris.
		Editor of <i>La Nature</i> .
		Physical Observatory, Meudon.
		Bureau Central Météorologique.
		Meteorological Society of France.
Mauritius		Observatoire Météorologique et Magnétique.
Melbourne, Victoria		
Mexico		
Milan		
Munich		
Nagpur		
Naini Tal		
New Haven, Connecticut		
New York, U. S.		
Nowgong-Rajshahye		
Ootacamund		
Oxford		
Paris		
Perpignan, France		

List of Recipients of the Publications of the Meteorological Office—concluded.

Perth, W. Australia	Surveyor General.
Pesaro, Italy	Royal Observatory.
Philadelphia	Franklin Institute.
Poona	Conservator of Forests, Bombay, Northern Division.
Prag, Bohemia	Observatory.
Raipur	Civil Surgeon of Raipur.
Rangoon	Chief Commissioner, Burma.
	Sanitary Commissioner, ditto.
	Conservator of Forests, ditto.
	Editor of the <i>Rangoon Times</i> .
Rome	Meteorological Office (Ministry of Agriculture).
Rio de Janeiro	Imperial Observatory.
Saharunpore	Superintendent, Botanic Gardens.
Secunderabad	Secretary to the Resident at Hyderabad.
Shillong	Chief Commissioner of Assam.
	Conservator of Forests, Assam.
Simla	Assistant Quarter Master General, Intelligence Branch.
Singapore	Principal Civil Medical Officer, Straits Settlements.
Stockholm	Nautisk Meteorologiska Byran.
St. Petersburg	Observatoire Physique Central.
	Geographical Society of Russia.
	Prof. H. Wild, Central Physical Observatory.
Strasburg	Imperial University Library.
Stonyhurst	Stonyhurst College Observatory.
Sydney	Observatory.
	University Library.
Syracuse, Sicily	Royal Meteorological Observatory.
Tasmania	Royal Society.
Tiflis, Russia	Physical Observatory.
Tokei, Japan	Imperial Mining Office.
	Imperial Meteorological Observatory.
Toronto, Canada	Magnetical and Meteorological Observatory.
	Royal Astronomical Observatory.
Turin	Meteorological Society of Italy.
Upsala	Meteorological Observatory.
Utrecht	Royal Netherlands Meteorological Institute.
	K.K. Central-Anstalt für Meteorologie und Erdmagnetismus.
	K.K. Geologische Reichsanstalt.
Vienna	Imperial Academy of Sciences.
	Dr. J. Hann.
Vizagapatam	A. V. Nursingrow, Esquire.
	Chief Signal Officer, United States Army.
	Smithsonian Institution.
Washington, U. S.	Naval Observatory.
	Hydrographic Office.
	Professor Cleveland Abbe, Signal Office.
	United States Geological Survey.
Wellington, New Zealand	Observatory.
Woolwich	Royal Artillery Library.
Zi-ka-wei, Shanghai	Magnetical and Meteorological Observatory.
Zurich	Central Meteorological Institute.

APPENDIX G.

Presentations to the Library from the 1st April 1885 to the 31st March 1886.

Place.	Donors.	Title of work.
ALGIERS . . .	Meteorological Service . . .	{ Bulletin Météorologique du Gouvernement général de l'Algérie, 16th February 1885 to 15th February 1886. Bulletin Mensuel, December 1884, and February to June 1885.
ALLAHABAD . . .	Meteorological Office . . .	{ Administration Report of the Meteorological Reporter to the Government of the North-Western Provinces and Oudh for the year 1884-85. Sketch of the Meteorology of the year 1884 in the North-Western Provinces and Eastern Rajputana.
AMSTERDAM . . .	Royal Academy of Sciences . . .	{ Verslagen en Mededeelingen der Koninklijke Akademie van Wetenschappen Afd Natuurkunde, Tweede Reeks, Deels XIX and XX. Processen verbaal, 1883-84. Naam en zaakregister op Akad. &c., Tweede Reeks, Deel I—XX. Jaarboek, 1883.
BATAVIA . . .	Magnetical and Meteorological Observatory.	{ Rainfall in the East Indian Archipelago, sixth year, 1884. Observations made at the Magnetical and Meteorological Observatory in Batavia, Vol. VI, parts I and II.
BERLIN . . .	{ Austrian and German Meteorological Society. Dr. G. Hellman Royal Prussian Statistical Bureau	{ Meteorologische Zeitschrift, January and February 1886. Ueber gewisse Gesetzmässigkeiten im Wechsel der Witterung aufeinanderfolgender Jahreszeiten. Proussische Statistik-Ergebnisse der Meteorologischen Beobachtungen im Jahre 1884.
BOMBAY . . .	{ Government of Bombay Government Observatory . . . Meteorological Office . . .	{ Annual Report of the Sanitary Commissioner for the Government of Bombay for 1884. Bombay Gazetteer, Vol. XVIII, parts I to III. Magnetical and Meteorological observations made at the Government observatory, Bombay, during the years 1883 and 1884. Brief sketch of the Meteorology of the Bombay Presidency in 1883-84.
BOSTON . . .	Reception Committee . . .	{ Addresses at the Complimentary dinner to Dr. Benjamin Apthorp Gould. Bulletin, 3rd series, Tomes VI to VIII.
BRUSSELS . . .	Royal Academy of Sciences . . .	{ Annuaire, 1884 and 1885. Jours de solitude.
BUCHAREST . . .	Institutul Meteorological Romaniei	{ Buletinul Ministerului agriculturii, industriei, comerçului si domenitor, Anul I, 1885, Nos. 2 to 7.
BUDAPESTH . . .	K. Central Anstalt für Meteorologie- und Erdmagnetismus.	{ Jahrbücher. Bände X to XIV.
CALCUTTA . . .	{ Comptroller and Auditor General . Director-General of Post Offices in India. Geological Survey of India . . . Government of Bengal . . .	{ Civil Budget Estimate for the year 1885-86. Indian Postal Guide, No. XXV, October 1885. Memoirs of the Geological Survey of India, Vol. XXI, parts 3 and 4. Records of the Geological Survey of India, Vol. XVIII, parts 2 to 4; Vol. XIX, part I. Returns of the rail-borne traffic of Bengal during the quarters ending 31st March 1884, and 31st March, 30th June and 30th September 1885. Report on the external trade of Bengal with Nepal, Sikkim, and Bhutan for 1884-85. Report on the rail-borne traffic of Bengal during the year 1884-85. Report on the river-borne traffic of the lower provinces of Bengal and on the inland trade of Calcutta and on the trade of Chittagong and the Orissa ports for the year 1884-85.

Presentations to the Library from the 1st April 1885 to the 31st March 1886—continued.

Place.	Donors.	Title of Work.
CALCUTTA— <i>concl'd.</i>	Government of India, Home Department	Report of the Meteorological Council to the Royal Society for the year ending 31st March 1884. Forest Department; Code of Instructions.
	Government of India, Revenue and Agricultural Department	Appendix to the Report of the Indian Famine Commission, Vol. VI. Report of the Indian Famine Commission, Part III, Famine Histories. Official Report of the Calcutta International Exhibition, 1883-84, Vols. I and II. Administration Report on the Madras Observatory for the year 1884.
	Henry F. Blanford, F.R.S.	Connexion of the Himalayan snowfall with dry winds and seasons of drought in India. (Pamphlet.)
	Meteorological Office, Bengal	Administration Report of the Meteorological Reporter to the Government of Bengal for 1884-85.
	Sanitary Commissioner with the Government of India	Annual Report of the Sanitary Commissioner with the Government of India for 1884.
	St. Xavier's College Observatory	Meteorological observations recorded at the St. Xavier's College Observatory, July 1884 to December 1885.
	Surveyor General of India	General Report on the operations of the Survey of India Department during 1883-84.
	University	Twenty-first Annual Report of the Library Syndicate.
CAPODIMONTI (NAPLES).	Astronomical observatory	Ricerche Numeriche sulla latitudini del R. Osservatorio di capodimonti, part I.
CARLSRUHE	Bureau für Meteorologie und Hydrographie, Baden	Jahres-Bericht für das Jahr 1884. Beiträge zur Hydrographie des Grossherzogthums Baden, Zweites Heft.
CHRISTIANIA	Norwegian Meteorological Institute	Jahrbücher für 1881, 1882, and 1884.
COLOMBO	Surveyor General of Ceylon	Administration Report, 1884 (Part III, Scientific) Meteorology.
COPENHAGEN	Institut Météorologique Danois	Bulletin Météorologique du Nord, February 1885 to January 1886.
	Royal Academy of Sciences	Oversigt, No. 3 of 1884 and Nos. 1 and 2 of 1885.
CORDOBA	National Academy of Sciences	Boletín de la Academia Nacional de Ciencias en Cordoba (Republica Argentina), Tomo VII, Entrega 3a and 4a; Tomo VIII, Entrega, 1 ^a . Anales de la oficina Meteorologica Argentina, Tomo IV.
	Oficina Meteorologica Argentina	Actas de la Academia Nacional de Ciencias en Cordoba, Tomo V, Entrega segunda. Informes Annales y documentus.
	Editor, Indian Forester	Indian Forester, April 1885 to March 1886.
DEHRA DUN	Trigonometrical Branch, Survey of India	Spirit-levelled heights in the Thana, Nasik, and Khandesh districts of Bombay, and in Dhar, Dewas, Gwalior, Bhopal and Tonk Native States of the Central India Agency.
DORPAT	Meteorological Observatory	Anemometrische Scalen für Dorpat.
DUBLIN	Royal Dublin Society	Scientific proceedings, Vol. III, New series, Parts 5 to 7; Vol. IV, New series, Parts 1 to 6. Scientific Transactions, series II, Vol. I, Nos. 15 to 25; Vol. II, Nos. 2-3; Vol. III, Nos. 1 to 6.
	Scottish Meteorological Society	Journal, 3rd series, No. II.
GREENWICH	Magnetical and Meteorological Observatory. Deutsche Meteorologische Gessellschaft.	Greenwich Magnetical and Meteorological Observations for 1883. Meteorologische Zeitschrift, February to December 1885.
HAMBURGH	Deutsche Seewarte	Meteorologische Beobachtungen in Deutschland für 1877, 1878, and 1882. Monatliche Uebersicht der Witterung, July to December 1884 and the year 1884; January to April 1885. Wetterbericht, Vol. X, Nos. 60 to 365; Vol. XI, Nos. 1 to 31. Aus den Archiv der Deutschen Seewarte, 1882 and 1883.

Presentations to the Library from the 1st April 1885 to the 31st March 1886—continued.

Place.	Donors.	Title of Work.
HAVANNA . . .	Real Colegio de Belen	Observaciones Magneticas y Meteorologicas, January to June 1876; January to June 1885.
		Lunar-Transits across the meridian of Hongkong.
		Report on the height of Victoria Peak.
		Five-day means of the principal meteorological elements for 1884.
		Annual Weather Report for 1884.
HONGKONG . . .	Observatory	Notice to mariners of the signs of approaching Typhoons.
		Weather Report for August 1884 to November 1885.
		Progressive motion of Typhoons in 1884.
		Observations and Researches made at the Hongkong Observatory in the year 1884.
		Report of the Iowa Weather Service for September 1881 to December 1882.
		Third Biennial Report of the central station of the Iowa weather service.
IOWA	Weather Service	The seasons in Iowa and a calendar for 1884.
		Bulletin of the Iowa Weather Service, January to May 1883.
JEYPORE	Dr. T. H. Hendley	Annual Report of the Jeypore medical and meteorological institutions for 1884.
		Report of the Land Revenue Settlement of the Dera Ismail Khan District, 1877 to 1879.
		Volume of maps to accompany the Dera Ismail Khan Settlement Report.
		Report on the Land Revenue Settlement of the Bannu District, 1872 to 1878.
		Volume of maps connected with the Settlement Report of the Bannu District.
LAHORE	Government of the Punjab	Report on the Meteorology of the Punjab for 1884-1885.
	Meteorological Office	The fixed idea of astronomical theory.
LEIPZIG	Augustus Tischner	Jahrbuch, 1884.
	Meteorological Instituto	Symons's Monthly Meteorological Magazine, February 1885 to February 1886.
	G. J. Symons, Esq. . . .	The discovery of the periodic law and the relations among the atomic weights.
	John A. R. Newlands	Principles of forecasting by means of weather charts.
		Quarterly Weather Report, Parts I to IV of 1877.
		Weekly Weather Report, New Series, Vol. I, Nos. 44 to 52; Vol. II, Nos. 1 to 46.
		Monthly Weather Report, November 1884 to August 1885.
		Hourly readings, Part IV of 1882; Parts I and II of 1883.
		Meteorological observations at stations of the second order for the year 1880.
		Report of the Meteorological Council to the Royal Society for the year ending March 1884.
		Daily Weather Report, 1st July to 31st December 1884; 1st January to 30th June 1885.
		Contributions to our knowledge of the Meteorology of the Arctic regions, Part IV.
LONDON ; . . .	Meteorological Office	Journal, Vols. X, XVII, and XVIII, part I.
	Royal Asiatic Society	List of Fellows of the Royal Meteorological Society, 1st February 1885.
	Royal Meteorological Society	The Meteorological Record, Nos. XV to XVIII.
		Quarterly Journal, New Series, Vol. XI, Nos. 53 to 56.
	Royal Society	Proceedings, Vol. XXXVII, Nos. 233 and 234; Vol. XXXVIII, Nos. 235 to 239.

Presentations to the Library from the 1st April 1885 to the 31st March 1886—continued.

Place.	Donors.	Title of Work.
LONDON—concl'd.	Society of Arts	Journal, Nos. 1686 to 1737.
	Solar Physics Committee	Index to Journal, Vols. I to X and XI to XX.
		Dates of coincidence of the assumed prime meridian of the sun with the central meridian of the visible hemisphere.
		Madras magnetical observations, 1851 to 1855.
MADRAS	Government Astronomer	Singapore magnetical observations, 1841 to 1845.
		Telegraphic longitude determination in India.
	Government of Madras	Annual Administration Report of the Forest Department (Southern and Northern Circles), Madras Presidency, for the year 1883-84.
	Meteorological Office	Administration Report of the Meteorological Reporter to the Government of Madras for 1884-85.
MADRID	Royal Observatory	Anuario, Ano XVIII, 1880.
		Observaciones meteorologicas, 1879 to 1881.
		Resumen de las observaciones meteorologicas de provincias, 1876 to 1882.
MANCHESTER	Literary and Philosophical Society	Memoirs of the Literary and Philosophical Society, 3rd series, Vol. VIII.
		Proceedings, Vols. XXIII and XXIV.
MAURITIUS	Royal Alfred Observatory	Mauritius meteorological results for 1882 and 1883.
MELBOURNE	Observatory	Monthly record of results of observations in Meteorology, Terrestrial Magnetism, &c., taken at the Melbourne Observatory from October 1884 to October 1885.
MEXICO	Central Meteorological Observatory	Boletin del Ministerio de Fomento de la Republica Mexicana, Tomo IX, Nos. 65 to 80; Tomo X, Nos. 1-36, 43-113.
		Resumen comparativo correspondiente a los Años de 1877-1884.
		Estudios de meteorología comparada, Tomo I.
MILAN	R. Osservatorio di Brera	Sui temporali osservati nell'Italia superiore durante l'Anno 1879.
MONCALIERE	Central Observatory	Osservazione delle meteore luminose nell' Anno 1884 and 1885.
	Geographical Society	Jahresbericht für 1884.
MUNICH	Royal Bavarian Academy of Sciences.	Astronomisch-geodätische Bestimmungen, ausgeführt an einigen Hauptpunkten des Bayerischen Dreiecksnetzes.
		Nachträge zu den zonenbeobachtungen der Sternwarte bei München.
		Sitzungsberichte der mathematisch physikalischen class, Hefte II to IV of 1884; Heft I of 1885.
		Abhandlungen der mathematisch physikalischen classe, Band X, parts I and II.
NAGPUR	Chief Commissioner, Central Provinces.	Returns of rail-borne traffic during the quarters ending 31st December 1884, and 31st March, 30th June and 30th September 1885.
		Report on the Nagpur Experimental Farm in the Central Provinces for the year 1884-85.
		Report on the railway-borne traffic of the Central Provinces for 1884-85.
		Forecast of linseed crop in 1886 in the Central Provinces.
		Forecast of wheat crop in 1886 in the Central Provinces.
		Review of the Agriculture and Revenue Reports of the Central Provinces for the year 1884-85.
NEW HAVEN	Connecticut Academy of Arts and Sciences.	Transactions, Vol. VI, part 2.
NEW YORK	Meteorological Observatory	Abstract of registers from self-recording instruments, December 1884 and January to November 1885.
		Annual Report for 1884.
OXFORD	Radcliffe Observatory	Results of meteorological observations made at the Radcliffe Observatory, Oxford, in the year 1882.

Presentations to the Library from the 1st April 1885 to the 31st March 1886—continued.

Place.	Donors.	Title of Work.
PARIS	Bureau Central Météorologique de France.	Bulletin International, Vol. XXIX, Nos. 58 to 365; Vol. XXX, Nos. 1 to 56. Annales du Bureau Central Météorologique de France, Année 1881, Tome IV; Année 1882, Tomes I, III, IV.
	Meteorological Society of France	Rapport du Comité Météorologique International, Réunion de Copenhague, 1882. Annuaire, December 1882; April to December 1884; January to April 1885; January 1886.
PERTH (W. Australia)	Meteorological Office	Western Australia Meteorological Report for 1884.
PHILADELPHIA	Franklin Institute	Journal, March 1885 to February 1886.
POLA	K. K. Hydrographisches Amt	Meteorologische und Magnetische Beobachtungen, January to September 1885 and November 1885 to January 1886.
PRAGUE	Observatory	Magnetische und Meteorologische Beobachtungen im Jahre 1884.
ROUSDON	C. E. Peck, Esq.	Meteorological observations taken at the Rousdon Observatory during the year 1884.
SIMLA	Inspector General of Forests	Report on Forest Administration in the Chota-Nagpur Division of Bengal. Review of Forest Administration in British India during the year 1883-84.
SINGAPORE	Colonial Secretary, Straits Settlements.	Straits Settlements Meteorological Returns for 1884.
	Physical Observatory	Annalen des Physikalischen Central observatoriums, Jahrgang 1883.
ST. PETERSBURGH	Dr. M. A. Woeikof	Les Rivières et les Lacs de la Russie. Flüsse und Landseen als Produkte des Klimas. Temperaturänderung mit der Höhe in Bergländern und in der freien atmosphäre. Die Regenverhältnisse des Malayischen Archipel. Étude sur la température des eaux et sur les variations de la température du globe. Influence of accumulations of snow on climate. Klima an der Lenamündung nach einjährigen Beobachtungen.
STONYHURST	Stonyhurst College Observatory	Results of meteorological and magnetical observations, 1884.
SYDNEY	Observatory	Results of rain and river observations made in New South Wales during 1884.
SYRACUSE	Central Observatory	Osservazioni meteorologiche, Vol. VIII, Nos. 6—12, Vol. IX, Nos. 1—12.
TASMANIA	Royal Society	Papers and Proceedings of the Royal Society of Tasmania for 1884.
TIPLIS	Physical Observatory	Meteorologische Beobachtungen im Jahre, 1883 und 1884. Beobachtungen der Temperatur des Erdbodens im 1882 und 1883. Physikalisches observatorium im Jahre 1881. Magnetische Beobachtungen im Jahre 1883.
TOKIO	Imperial Meteorological Observatory	Monthly summaries and means for the year 1884, with 41 maps. Report of the Meteorological observations in the Empire of Japan for January to May 1884.
	University	Measurement of the force of gravity and magnetic constants at Ogasawara-jima (Bonier Island). Monthly Weather Review, January to December and year 1885; January 1886.
TORONTO	Meteorological Office	Report of the Meteorological Service of the Dominion of Canada for 1883.
TURIN	Osservatorio dell Università di Torino.	Effimeride del sole, della Luna e dei principali Pianeti calcolati per Torino in tempo medio civile di Roma per l'anno 1886. Osservazioni dell'ecalisse totale di luna del 4—5 Ottobre 1884. Sulla possibilità che il vulcano Krakatoa possa avere proiettato materie fuori dell'atmosfera. Sulla frequenza dei venti inferiori deseinta dalle osservazioni fatti dal 1866 al 1884. Bolletino dell osservatorio Anno XIX, 1884.

Presentations to the Library from the 1st April 1885 to the 31st March 1886—concluded.

Place.	Donors.	Title of Work.
TURIN— <i>concl'd.</i>	Società Meteorologica Italiana	Bolletino decadico Ano XIII, Nos. 3 to 12; Ano XIV, 1 to 5. Bolletino Mensuale, Serie II, Vol. IV, Nos. 1 to 12; Vol. V, Nos. 1 to 7, 9 and 10. Mesures des hauteurs et des mouvements des Nuages.
UPSALA	N. Ekholm et K. L. Hagström Observatoire météorologique de l'Université.	Bulletin Mensuel, Vol. XVI, Année 1884. Rapport du Comité météorologique international.
VIENNA	Dr. J. Hann K. K. Central Anstalt für Meteorologie und Erdmagnetismus. K. K. Geologische Reichsanstalt.	Zeitschrift der oesterr. Meteor. Gesellschaft, Band XX, March to December 1885 and Index. Internationaler telegraphischer Wetterbericht, Vol. IX, Nos. 42 to 365; Vol. X, Nos. 1 to 15. Jahrbücher, neue Folge, Band XIX, Jahrg. 1882; Band XX, Jahrg. 1883; Band XXI, Jahrg. 1884. Verhandlungen, Nos. 14 to 18 of 1867; Nos. 3-9 of 1868; Nos. 7-10 of 1871; Nos. 3 to 18 of 1885. Jahrbuch, Band XVII, No. 4; Band XVIII, Nos. 1 and 2.
VIZAGAPATAM	A. V. Nursingrow, Esq. Chief Signal Office	Results of meteorological observations recorded at G. V. Juggarow's Observatory, Vizagapatam, during 1884. Bulletin of International Meteorology, January to December 1884. Monthly Weather Review, January to November 1885. Professional Papers of the Signal Service, Nos. 13, 15, 16 and 18. Report of the Chief Signal Office for 1883.
WASHINGTON.	H. A. Hazen Smithsonian Institution United States Naval Observatory	Daily International Meteorological Observations, 1st July to 31st December 1883. Determination of air temperature and humidity. Tornadoes. Guyot's tables for computing differences of elevation from barometric observations. Results of meteorological observations made at the United States Naval Observatory during the years 1881 and 1882.
WELLINGTON (NEW ZEALAND).	Meteorological Office	Abstract of meteorological observations, New Zealand, for the quarter ending December 1884. Bulletin mensuel, April to December and year 1884; January to April 1885.
ZI-KA-WEI	Magnetical and Meteorological Observatory	Mouvements des couches élevées de l'atmosphère à Zi-ka-wei déterminés par la direction des Cirri. Typhoons of the Chinese Seas in the year 1885.
ZURICH	Swiss Meteorological Institute	Annalen der Schweizerischen meteorologischen Central Anstalt, 1883. Meteorologische Beobachtungen, January to November 1885.

Purchases for the Library.

American Journal of Science, January 1882 and March 1885 to February 1886.
Annalen der Physik und Chemie, Nos. 3 to 12 of 1885; Nos. 1, and 2, 1886.
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REPORT
ON THE
ADMINISTRATION OF THE METEOROLOGICAL DEPARTMENT
OF THE GOVERNMENT OF INDIA

IN
1886-87.

PART I.—GENERAL.

As I am about to leave India for some months, and to make over the charge of the Department to Mr. J. Eliot for the period of my absence, I must of necessity delegate to him the duty of summarising the several provincial reports, which are not drawn up and communicated to the Head Office until after the end of the financial year, and my own remarks will be restricted to those general topics, which have either engaged my own attention, or have been the subject of correspondence during the past year.

ACTINOMETRIC OBSERVATIONS.—In the Report on the Administration of the Department for the year ending 31st March 1886, it was announced that Sergeant Rowland, the actinometric observer, and Mr. H. Shaw, assistant observer, had returned from Leh in November 1885, the experience of two years at that remote station having shown conclusively that, so far from being specially fitted for actinometric work, it afforded no greater serenity than do many readily accessible stations in the outer Himalaya. The period of Sergeant Rowland's engagement under the sanction of the Secretary of State having expired, at the request of the Surveyor General, and with the sanction of Government, his services were transferred to the Survey Department at Dehra, and Mr. Shaw was retained as actinometric observer under the direction of Colonel Haig, R.E., to carry on the work at Mussooree, as a tentative measure, and in order to ascertain, by sufficient trial, how far that station is fitted for future systematic work. Up to October 1886, such assistance as he required was provided under Colonel Haig's direction from the Survey Establishment, the cost being charged to the Meteorological Department, and on the withdrawal of the Survey Establishment from Mussooree

at the end of the hill season, a native assistant was appointed to assist Mr. Shaw, and at the same time to carry on continuously the meteorological observatory at Mussooree, which has hitherto been established only during the summer months. Moreover, the observatory was raised to the rank of a second class observatory, the only one (with the exception of Leh) yet established at a Himalayan station.

From December 1885 to the beginning of May 1886, Mr. Shaw was engaged in comparing all the instruments in stock with a view to their reduction to a common standard. He was able to get observations on 42 days from the 1st December to the 3rd May, but of these the greater part, although probably capable of being turned to account, were unsystematic. From that time to the end of March 1887, the following systematic observations were secured, all short series:—

MONTHS.	DAILY SERIES.	
	Complete.	Incomplete.
May (from 16th) 1886	3	5
June „	1	6
July and August „	0	0
September „	0	3
October „	6	15
November „	8	12
December „	4	12
January 1887	0	6
February „	4	9
March „	12	3

So far, Mussooree would seem to be as favourable for the purpose of actinometric work as was Leh, but the seasons are different. At Leh, most observations were obtained in the months of the Indian summer monsoon, as the rains hardly penetrate to Leh as a rule. At Mussooree, these months afford scarcely a single clear day, while October and November are those of greatest serenity.

The registers obtained at Leh have been sent home to the Solar Physics Committee, at whose instigation the work was undertaken. Their receipt has been acknowledged, but I have as yet had no report of the results of their examination.

SUNSHINE RECORDS.—Since writing my report for last year, I have learned that a record of the daily duration of sunshine has been kept at Dehra Dun since February 1882, that is from an earlier date than any other station, and by the courtesy of Colonel Haig the traces of all past years have been lent to the Meteorological Office for measurement and tabulation. The Lahore register was commenced in December 1885, and that of Bombay in August 1886. That of Nagpur has not yet been begun, owing apparently

to some difficulty in finding a suitable site for the instrument. The records now available are the following :—

Dehra Dun	.	.	.	.	.	Since	February	1882.
Allahabad	.	.	.	.	.	"	April	"
Calcutta	.	.	.	.	.	"	January	1883.
Jeypore	.	.	.	.	.	"	February	1884.
Lahore	.	.	.	.	.	"	December	1885.
Bombay	.	.	.	.	.	"	August	1886.

GROUND TEMPERATURE.—No addition has been made to the stations registering the temperature of the ground. As in the previous year, they are five in number, *viz.*—

Calcutta (Alipore)	.	.	.	.	.	Since	April	1878.
Allahabad	.	.	.	.	.	"	May	1880.
Dehra	.	.	.	.	.	"	June	1881.
Jeypore	.	.	.	.	.	"	August	1881.
Lahore	.	.	.	.	.	"	August	1885.

During the past year, Mr. Hill has investigated the Allahabad ground temperatures of the last six years, and has prepared a memoir on the results, which will shortly appear as an official publication of the Department. Some of these results are of very great interest. In the first place, they fully confirm the general conclusion which I had long since deduced from other registers of the kind in India, *viz.*, that the average temperature of the ground is about 5° above that of the air, and for this Mr. Hill suggests the very probable explanation that, owing to the circulation of the atmosphere and the constant intermingling of its different parts, the air temperature must be more uniform all over the earth than it would be, if determined at each place solely by a balance between the gain and loss of heat locally absorbed from the sun or given out by radiation, whereas the temperature of the ground is entirely so determined. It follows therefore that India being one of the hottest regions on the earth's surface, the air temperature should there be below that of the ground, and Mr. Hill suggests that in arctic and antarctic regions the ground should be cooler than the air.

Another conclusion of much interest is that, while the temperature of the ground fluctuates greatly with the abundance of the rainfall, and, of course, still more with the changes of day and night and with the season, there is also apparently a small oscillation of many years' duration, which may amount to about 4° Fahr. and which he finds to agree in its phases with the variation shown by the Allahabad (as by other Indian) registers to affect the air temperature and the intensity of the solar radiation. As the ground temperature registers at present extend over only six years, the length of this many year cycle (assuming that the variation is part of a cycle) must at present be little more than a matter of surmise ; but it is noteworthy that its minimum phase, like those of the air temperature and insolation, occurred in 1883, the year of maximum sunspots, while the minimum of the two latter oscillations occurred in 1878, a year of minimum sunspots.

ALLAHABAD OBSERVATORY (1st class).—The Van Rysselberghe's Meteorograph obtained in August 1880, for this observatory, was set up and began to work in March 1886. Whether, however, owing to original defects of construction, or, as seems more probable, to deterioration during the many years that it has been standing and occasionally

working at Calcutta, it has been far from fulfilling the expectations formed of it, and has been a constant source of difficulty. In the hands of any one less endowed with the patience of a scientific investigator, and less acquainted with the working of delicate electrical apparatus than Mr. Hill, it would doubtless have been condemned and set aside after a short trial, but Mr. Hill has taken very great pains to trace out the source of each failure as it has occurred, and to eliminate it at all events for the time. As, however, despite all endeavours, the meteorograph has never continued working many days without developing some new defect, I have considered it best to dismount the working parts and to send them home to the maker to be thoroughly overhauled and put in order. Meanwhile, the observatory establishment will be temporarily reduced, and hourly observations of the ordinary instruments will be recorded, until the meteorograph is returned restored to working condition.

In all other respects the working of the new observatory has been most satisfactory.

LAHORE OBSERVATORY.—Only a portion of the self-recording instruments destined for this observatory have as yet been received; *viz.*, the anemograph, the raingauge, and the sun-thermometer. The former has not yet been set up, as it is necessary to construct a tower at the observatory in order to give the instrument sufficient elevation, and, owing to financial considerations, this has not yet been done. The design for the tower has now been very much simplified, and the estimates cut down to the lowest limit compatible with suitability, and I confidently expect that the present year will witness the execution of this indispensable piece of work. The remaining instruments are expected shortly, and only a trifling outlay will be required for setting them up. Meanwhile, the observatory continues to work as a second class observatory under the local superintendence of Mr. Oman, Professor of Physics at the Lahore College.

EXTENSION OF THE METEOROLOGICAL SYSTEM TO UPPER BURMA.—As a consequence of the settlement of Upper Burma under British rule, a large tract of country of the meteorology of which scarcely anything was previously known has been brought within the operations of the department. Three fully-equipped meteorological observatories have been established in the new territory, *viz.*, at Mandalay, Bhamo, and Kindat, and, in addition, rainfall registers have been received for a portion of the year from ten other stations as follow:—

Station	From date.	Station.	From date.
Mandalay	May 1886.	Ye Methin	June 1886.
Yeu	"	Kindat	July 1886.
Shwebo	"	Toungdwingyee	"
Minbu	June 1886.	Bhamo	August 1886.
Mingyan (Pyinmana)	"	Fort Sagaing	September 1886.
Pagan	"	Mingin	"
Kyauksai	"		

The three observatories, above enumerated, very inadequately represent the enormous tract recently added to our possessions, and when the country is more readily accessible, it will certainly be desirable to add to their number. Meanwhile, some three or four years at least must elapse before the returns can be expected to afford more than some general information respecting the character of the climate, such as may indeed be of interest in questions of sanitation and agriculture, but can hardly throw much light

on the part played by Burma in the general scheme of Indian Meteorology. For this we must await the accumulation of at least three or four years' registers.

OTHER NEW OBSERVATORIES AND RAINGAUGE STATIONS.—One other observatory has commenced work during the past year, *viz.*, that at Cocos Island, which being situated between Diamond Island and Port Blair, and close to the cradle of most of the most violent storms that occur at the change of the monsoon, can scarcely fail to be a valuable addition to the system, if only proper care be given to render the work trustworthy. The first registers sent in are those for May 1886. At present, some of the most important instruments have not been put up, and no proper provision has been made for the exposure of others, so that it would be premature to pronounce on the value of the work.

Preparations have been made for establishing an observatory at Baghdad in connection with the British Political Residency, and the instruments have been despatched for the purpose.

There has also been some correspondence with reference to an observatory at Srinagar in Kashmir. This would be very valuable, if made permanent at the same spot but, as originally proposed, it was intended to move it backwards and forwards twice a year, a condition which would go far to deprive the registers of all value.

Through the courteous assistance of Colonel Brownlow, a third rainfall register has been obtained from Beluchistan, *viz.*, from Peshin, since January 1885, so that the highlands of Beluchistan are now as well represented as most other parts of India. It is, however, desirable to obtain some additional registers from the desert tract below the Bolan.

SNOWFALL REPORTS.—Reports on the snowfall of the spring of 1886, and also of the past winter, have been received from the following officers :—

The Deputy Commissioner, Kohat—

On the snowfall around the Peshawar valley, by Shahzad Sultan Jan and Captain H. P. Leigh, Assistant Commissioner.

The Deputy Commissioner, Rawalpindi—

On the snowfall of the hills around Murree and Kaluta.

The Deputy Commissioner, Kangra—

On the snowfall at Dharmsala by the Civil Surgeon.

On the snowfall of the passes around Kulu by D. C. Johnston, Esquire, Assistant Commissioner.

The Deputy Commissioner, Simla—

On the snowfall at Kilba and the passes around Bushahir by the Assistant Conservator of Forests.

The Superintendent, Dehra Dun—

On the snowfall of Mussooree.

The Senior Assistant Commissioner, Garhwal—

On the snowfall of the Sub-Himalayas.

The Collector or Senior Assistant Commissioner, Kumaon—

On the snowfall of the Johar pass and neighbouring ranges.

The Assistant Commissioner, Naini Tal—

On the local snowfall.

The Deputy Commissioner, Darjeeling—

On the snowfall of the passes of Sikkim.

The Superintendent of the Kailang Observatory—

On the snowfall of Lahoul, by the Rev. A. W. Heyde.

The Superintendent of the Leh Observatory—

On the snowfall of Ladak, by the Rev. F. A. Redslob,

From these it appears certain that up to the end of March 1887, the snowfall had been comparatively light on the North-West Himalaya, certainly much less than in 1886.

FORECAST OF MONSOON IN 1886.—From the reports received from the officers enumerated above, it appeared that the winter and spring snowfall on the North-West Himalaya and the hills of Eastern Afghanistan was considerable, and in January and February, greater than usual, but there was less than in the previous year, especially in the spring months, and the snowy range, as seen from Simla in May and the beginning of June, was less thickly covered than in 1885, and the snow did not extend to such low levels.

At the same time, the winds on the west coast of the peninsula were less northerly, and during the month of May, those of the Punjab were more southerly and easterly than usual. Hence, in a memorandum, dated 4th June, and published in the *Gazette of India*, it was inferred that there seemed no reason to anticipate a retardation of the monsoon.

It was further observed that the atmospheric pressure during May had been slightly below the average on the plains of the Punjab, Rajputana, Central India, Bombay, and the Central Provinces, but above it on the hills, on the plains of the North-Western Provinces and Bengal, and most so in Bengal. This condition, it was pointed out, was favourable to the advance of the easterly branch of the monsoon, and generally to southerly winds, on the assumption sanctioned by experience that these conditions would continue.

The results were entirely in accordance with the forecast. In the weather summary for June it is stated that "about the 6th June, south-east winds advanced from the Bay of Bengal up the Gangetic plain to the Punjab, but were generally restricted to the submontane districts. On the 13th, a small storm was formed off the Orissa coast and subsequently moved forward, first to Calcutta, and then north-west and west across Western Bengal and Central India. Thence it moved rapidly to Sirsa, and finally to the north of the Punjab. The rainfall accompanying this storm was rather heavy, and it ushered in the monsoon rains over the North-Western Provinces, Central India, and a large portion of Rajputana and the Punjab." "On the western coast, the monsoon current was weak during the first two weeks, and the rainfall was restricted to the more southern provinces. The rainfall of Malabar was rather below the average, but in the Konkan there was an excess."

In July, it is reported that the rainfall was generally heavier and better distributed than in the previous month. In August the rainfall was below the average in the Punjab, but in the North-Western Provinces to the east of the Ganges (except in Oudh), in North and East Bengal, Assam, and Cachar, the rainfall was greatly in excess of the average, but to the south of the Ganges it was, as a general rule, more or less deficient. There was, however, no drought.

THE LAWS OF DROUGHT IN INDIA.—During the last few months has been brought to a close an enquiry in which I have been long engaged, *viz.*, the vicissitudes of the Indian rainfall. In so doing it has been necessary to go over again ground that was much trodden some eight years ago, when the question whether the rainfall of India or that of any portion of the country varied in accordance with the well-known periodical variation of the sunspots and certain magnetic phenomena engaged much public attention. The result at which the most qualified persons then arrived with respect to the Indian rainfall, was that, in certain cases, there seemed to be some indications of such a periodical oscillation, but that the existing evidence was quite insufficient to admit of any definite proof or disproof.

One of the best known instances cited was the apparent fluctuation of the rainfall registered at the Madras Observatory since 1813, and which, originally pointed out by Mr. Norman Lockyer and afterwards by Mr. C. Meldrum, was much popularised when introduced to the lay public by the literary genius of Sir W. W. Hunter. It attracted the more attention that it was associated with another statement of very great interest to all, *viz.*, that famines tend to recur in Southern India in each sunspot cycle when the sunspots are at the minimum of size and frequency, and it was thought that the two classes of facts were mutually corroborative.

The apparently weak point of this identification was, that the series of droughts followed by famine or at least by scarcity which were adduced in support of this view, had notoriously occurred in very various parts of the peninsula; some in the Carnatic, some restricted to the North Deccan, or to Bellary and Mysore, and one which was most severe in Orissa and the Northern Circars; while of all the rainfall registers, extending far enough back to afford means of testing the question, only that of the Madras Observatory afforded any appearance of the periodical fluctuation with the sunspot cycle.

The question has now been re-examined by the light of all the numerous rainfall registers that have been accumulated in the Meteorological Office relating to the last 22 years, and with results that are somewhat striking. In the province of the Carnatic as represented by 38 stations, the first thirteen years of the period show a remarkably regular fluctuation. The rainfall fell to a minimum in 1867, when it was more than 9 inches below the general average of 35 inches. It then rose pretty steadily till 1872, when it was $11\frac{1}{2}$ inches in excess. Next, after a sudden drop to an average in 1873 (a very dry year generally), and a recovery in 1874, it declined during the following years to a minimum in 1876 (the last famine year), after which it oscillated somewhat irregularly, but on the whole moderately above the average till it again reached a maximum excess of $11\frac{1}{2}$ inches in 1884. Thus, in two complete sunspot cycles, there have been two complete cyclical oscillations in the rainfall, remarkably regular in the alternate rise and fall for the first 13 years and more variable, but still sufficiently regular to mark the oscillation during the last 9 years.

Treating the whole series by Bessel's harmonic formula, the terms of which being computed on the theory of chances and according to the method of least squares, are generally used for determining the formula of true periodic fluctuation when its period is known, it is found that on the mean of the two cycles (assumed to be of 11 years exactly), the variation of the rainfall, in so far as it was determined by a regular oscillation,* was 6.7 inches below the average of 35 inches in the years of minimum, and 7.3 inches above it in the years of maximum, making a range of 14 inches, or two-fifths of the average total; further, that the mean deviation of the rainfall of any one year from the periodic amount, thus computed, was ± 3.6 inches only, being of course sometimes greater, sometimes less.

This result shows that, in the Carnatic, there is really a tendency to drought at intervals of about 11 years, but not necessarily of such intensity as to be disastrous. In 1867, for instance, although the rainfall on the general mean of the province was more than 9 inches (or more than one-fourth) deficient, there does not appear to have been any serious suffering, and even in 1876, when the mean deficiency was $11\frac{1}{2}$ inches, it was only parts of the Carnatic that suffered famine.

* Of two periodic terms, had a third term been computed, the range shown would have been greater. But with the data of only two cycles it has been thought sufficient to restrict the development of the formula to the largest terms.

In all other parts of the peninsula, such regularity is not shown by the numerous registers now consulted. But this appears to arise from the cyclical variation being much more liable to disturbance by seasons of copious or deficient rainfall which are due to other and non-periodic causes.

Thus 1873 was a year of remarkably low rainfall in most parts of India. 1871 and 1878 were unusually wet years, the former generally, the latter only in the northern and western provinces of the peninsula. If the vicissitudes of the three years be left out of account, a cyclical oscillation is to be detected in the rainfall of the western provinces of the peninsula of the same character as in the Carnatic, and there is the same tendency to drought at intervals of about 11 years.

These facts tend to clear up the difficulties, above noticed, of reconciling the periodical recurrence of drought and famine in the peninsula with the failure of the rainfall registers, formerly consulted, to afford evidence of any such periodical fluctuation. The true facts only become apparent when a very large number of rainfall registers fairly representing the local variations are taken into account.

That droughts, frequently followed by famine, tend to recur in some part of inter-tropical India at intervals of 10 or 11 years, is evident from the table of past droughts given in the Report of the Indian Famine Commissioners, but it is to be noticed that, although the intervals of their recurrence are so near those of the sunspot minima, there is no such exact coincidence as would justify the assertion that they observe the same periodicity. The following table shows, in parallel columns, the years of drought in some portion of the Indian peninsula, extracted from that given in the Famine Commissioners' Report, and the years of minimum sunspots taken from Wolf's latest tables:—

Droughts.	Sunspot minima.
1782.	1784.
1791.	.....
1802.	1798.
1806.	.....
1812.	1810.
1823.	1823.
1832.	1833.
1844.	1843.
1853.	1856.
1865.	1867.
1876.	1878.

Three years of drought in the above list, *viz.*, those of 1791, 1802, and 1806, do not correspond even approximately to any year of sunspot minimum; while of the remainder, one coincides exactly, one occurred two years later, one one year later, one one year earlier, three two years earlier and one three years earlier. The majority of these latter droughts occurred therefore earlier than the sunspot minima, and can hardly be regarded as even probably an effect of the same solar conditions that determine the frequency of the spots; though there may be some yet unknown relation between their respective causes.

The droughts that have chiefly affected Northern India are less regularly periodical than those of intertropical India. There is however much in common between the meteorological conditions which accompany and may be said to cause them; especially in the undue persistence of those north-westerly or westerly land winds which are the characteristic winds of the spring months. And there is this further relation that in not less than

five instances of the eleven above enumerated, the drought in Southern India was followed in the succeeding year by one in Northern India ; generally any drought in North-Western and Central India affects to some extent the greater part of the Bombay Presidency and *vice versa*. This rule holds good of prolonged breaks in the rains, equally with droughts of a more serious character.

The most important law relating to the droughts of late years in Northern India, and which appears to hold good equally of temporary and prolonged suspension of the rainfall, is that they are preceded by heavy snowfall on the Himalaya, particularly the North-West Himalaya. Such was the case before the famines of 1868, 1877, 1878,* and also preceding the temporary droughts of 1880 and 1883. Some of these were felt in the northern provinces of the peninsula, as well as in North-Western and Central India, and the Orissa and Madras famine of 1865 was in like manner preceded by a heavy snowfall on the North-West Himalaya.

Until within the last few years, the recorded facts of the snowfall have been very meagre and casual ; but on the assumption, true in the main, though not absolutely, that the winter and spring snowfall of the Himalaya varies proportionally with the rainfall on the outer Himalaya and the sub-Himalayan hills, it appears that years of exceptionally heavy snowfall recur about the time of sunspot minima, just as do the droughts of the peninsula. The present data are insufficient to admit of any valid conclusion, whether in this case, as in that of Southern India, there is an actual periodical fluctuation of the winter and spring rain and snowfall, or whether, like the striking apparatus of a clock, some agency is set in action only at more or less definite epochs, being quiescent in the intervals. If the former be, as I think, on the whole, most probable, it follows a course of variation exactly opposite to that of the rainfall of the peninsula, since the years of maximum winter rain and snowfall, like the droughts of Southern India, occur about the epochs of minimum sunspots. Those on record during the last 22 years are :—

Maximum winter rainfall, N.-W. Himalaya.	Proportion to average = 100.	Sunspot minimum years.	Drought in
1864-65	149	.....	1865
1867-68	134	1867	1868
1876-77	166	.....	1877
1877-78	207	1878	1878

In 1884-85, a year and a half after a sunspot maximum, there was again an excessive snowfall, but only to the west of the Jumna in the Himalaya. It was especially heavy to the west of the Indus. In this year the rains of North-Western India were hardly affected, but the monsoon rains were retarded nearly two months on the Bombay coast ; and the rainfall was very deficient in the north of the Bombay Presidency. It has been previously

* The famine was restricted to Kashmir, where the snowfall was the heaviest on record. In North-Western India the rains were only retarded some four or five weeks.

observed by Mr. Hill (in 1877) that the winter rainfall of the North-Western Provinces is heaviest about the time of minimum sunspots or a little earlier, and that the summer rainfall varies in the opposite manner. This quite accords with the relations above pointed out between the snowfall and sunspot epoch on the one hand, and the apparent influence of the snow on the monsoon rains on the other.

One more coincidence has been detected, which is probably of physical importance. This is that during the whole period of drought; lasting from the end of July 1876 to August 1878, with but temporary and partial interruption, the barometer stood unusually high, not only all over India, but also over a great part of Asia on the one hand and in Australia and at the Mauritius on the other, with a shifting of the maximum from the southern to the northern hemisphere and *vice versa* at the alternate winter seasons. With the disappearance of this excessive pressure in August 1878, the rains became once more abundant. The only other year in which an excessive pressure was equally general in Asia and Northern Europe, *viz.*, 1860, was also a year of severe drought in the North-Western Provinces, Punjab, and Rajputana.

It will be the work of future years further to verify and give greater precision to these laws of drought, and by degrees, it may be hoped, to establish them on a sound physical basis.

INFLUENCE OF FORESTS ON RAINFALL.—The evidence collected in recent years bearing on this subject was noticed in the report for last year. Since then, I have visited the comparative observatories at Dehra and Ajmere, with the exception of such as are at a distance from the latter station. The Dehra observatories are well situated and the arrangements were excellent, with the exception that the observer had removed from the raingauges the bottles intended to receive the rainwater, which therefore collected in the outer cylinder and must have been somewhat unduly exposed to evaporation. As however the receivers of both observatories were treated alike, it is probable that for the purpose of comparison the results are not much vitiated.

There are two pairs of observatories at Dehra, each pair consisting of one within the forest, the other on the open ground without, and each observatory has two gauges, the one on the ground, the other on a scaffolding 60 ft. above it. At the Ramgarh forest the two observatories are 2,250 ft. apart, at the Rajah's forest 2,750 ft. The following are the results of the rainfall measurements in 1886, which may be compared with those given in last year's report:—

Comparative measurements of rainfall within and without forests.

RAMGARH FOREST—DEHRA DUN.

	RAINGAUGE ON GROUND.			RAINGAUGE 60 FT. ABOVE GROUND.		
	I in forest.	O outside forest.	Diff. I—O.	I in forest.	O outside forest.	Diff. I—O.
January	3'54	3'46	0'08	3'37	3'47	—0'10
February	1'64	1'57	0'07	1'56	1'47	0'09
March	3'64	3'44	0'20	3'39	3'25	0'14
April . . . . .	...	...	...	...	...	...
May	2'42	2'48	—0'06	2'12	2'18	—0'06
June	3'43	3'52	—0'09	2'91	3'05	—0'14
July	31'19	29'42	1'77	29'63	28'02	1'61
August	28'76	29'26	—0'50	27'86	28'51	—0'65
September	8'63	8'70	—0'07	8'50	8'54	—0'04
October	3'16	3'22	—0'06	3'03	3'14	—0'11
November . . . . .	...	...	...	...	...	...
December	1'18	1'11	0'07	1'07	0'97	0'10
	87'59	86'18	1'41	83'44	82'60	0'84

RAJAH'S FOREST.—DEHRA DUN.

	RAINGAUGE ON GROUND.			RAINGAUGE 60 FT. ABOVE GROUND.		
	I in forest.	O outside forest.	Diff. I—O.	I in forest.	O outside forest.	Diff. I—O.
January	3'85	3'40	0'45	3'73	3'32	0'41
February	1'54	1'57	—0'03	1'44	1'47	—0'03
March	3'30	3'30	0	3'09	3'09	0
April . . . . .	...	...	...	...	...	...
May	2'48	2'47	0'01	2'22	2'16	0'06
June	3'89	3'85	0'04	3'46	3'46	0
July	31'23	30'53	0'70	29'59	29'04	0'55
August	29'78	29'98	—0'20	29'00	29'10	—0'10
September	8'77	8'76	0'01	8'59	8'58	0'01
October	3'53	3'66	—0'13	3'44	3'55	—0'11
November . . . . .	...	...	...	...	...	...
December	1'01	1'01	0	0'83	0'84	—0'01
	89'38	88'53	0'85	85'39	84'61	0'78

In both cases, the net result of the year is to show a small excess of rain at the inner observatories, amounting to about 1 per cent. This is less than was given by the previous year's register at the Ramgarh forest, but greater than that of the Rajah's forest, being however in the same direction, *viz.*, in favour of the forest. The near proximity of the two observatories of each pair would of necessity prevent any great difference in the results, but so far as they go, they confirm previous conclusions.

The Ajmere forest, in the immediate vicinity of the station, is of such a character that it can have but little influence on the rainfall. The only difference between the protected forest and the unprotected area outside, is that the former has a good growth of bushy scrub, which is absent from the latter. Trees are about equally frequent in both. Any difference that may be shown by the raingauges within and without the forest is as likely to be due to differences in the form of the ground as to any differences in the vegetation. I understand that the forests to the south of Ajmere are better grown and more suited for testing the variations of the rainfall, but these I did not visit.

Since writing the report of last year, I have gone more at length into the question therein discussed, *viz.*, the effect of forest protection in the Central Provinces on the rainfall, and I find that the evidence afforded by the rainfall registers is even more favourable to the assumption that forests increase the rainfall than was demonstrated in the report of last year.

The facts adduced in the report of last year showed that the average rainfall of the 10 years that had elapsed since the suppression of the Dáhya cultivation, was more than 6 inches, or about 13 per cent. greater than the average of the 9 to 11 years antecedent. But it was not shown how this increase had taken place; whether, *e.g.*, it was due to the inclusion of one or two years of exceptionally heavy rainfall in the later period and of one or more years of drought in the earlier, or whether, on the other hand, the registers showed a steady increase from the time of the change. It is clear that the interpretation to be put on the fact of the increase would be very greatly influenced by this consideration. The following comparative table of the mean annual rainfall of 14 stations, situated in that part of the Central Provinces most affected by the forest protection, shows that the increase has been progressive. Thus, the only year with more than 60 inches is the last but one of the series of 19 years, the three years with more than 57 inches are included in the last five years; of the seven years with more than 55 inches, six have occurred since the suppression of the Dáhya, and of the five years with less than 50 inches, four occurred before the change of system and the last was only two years after it:—

*Table of the mean annual rainfall of the forest region of the Central Provinces
from 1867 to 1885.*

Year.	Condition.	Mean rainfall.
		Inches.
1867	Under Dálhya.	55'08
1868	"	33'59
1869	"	47'97
1870	"	50'42
1871	"	45'52
1872	"	53'31
1873	"	39'18
1874	"	50'48
1875	Protected.	56'60
1876	"	42'32
1877	"	52'50
1878	"	52'47
1879	"	55'67
1880	"	51'83
1881	"	57'90
1882	"	54'22
1883	"	57'73
1884	"	64'63
1885	"	57'43

Another case illustrative of the influence of forests on rainfall, which I have investigated during the past year, is that of the Changa Manga plantation in the Punjab. The following account of this case is taken from a memoir on the rainfall of India that will shortly be published in the Indian Meteorological Memoirs :—

“ In the very heart of the plain between the Ravi and the Jhelum (two of the five rivers of the Punjab) and about 50 miles to the south of Lahore, a vigorous forest has been established by planting, and irrigating the planted land, from the Bari Doab Canal. The forest area covers 31½ square

miles, and has now been established 20 years.* Outside the forest and to the east and south-east, are lands which are cultivated also with irrigation from the canal; and on the margin of this tract, 4 miles from the forest is the small civil station Chunian. Since 1864 a rainfall register has been kept regularly at Vahu (within the forest $\frac{1}{2}$ mile distant from the nearest forest boundary, and $6\frac{1}{2}$ miles north of Chunian) and also at Chunian, and since 1870 a third register has been kept at Bhambeh, a station on the Bari Doab Canal, in a position very similar to Chunian, but 13 miles to the north-east of the forest boundary and 19 miles north-east from Changa Manga or Vahu.

"The rainfall chart of the Punjab shows that in this part of the province there is a steady increase of rainfall in a north-east direction or from Chunian to Bhambeh—steady, that is to say, apart from the influence of purely local conditions; and therefore, were the whole surface of the tract such as it is immediately around Chunian and Bhambeh, it might be anticipated that the mean rainfall of any intermediate station should be intermediate between those of Chunian and Bhambeh, in inverse proportion to their respective distances. The mean rainfall of Bhambeh, deduced from 17 years' registers, is 17.27 inches; that of Chunian, deduced from the same period, is 14.05 inches. If then, Vahu, which is 19 miles from the former and $6\frac{1}{2}$ miles from the latter station, had a rainfall intermediate between the above amounts in inverse proportion to the distances of the two stations the average of the same 17 years would be 14.85 inches. It is actually 15.76 inches, or nearly 1 inch above the computed proportion.

"I am far from considering this result as conclusive on the point at issue. In some years, the deviation from the mean proportions is very large, and the averages of the last three years (which, in this part of the Punjab, have been characterised with a remarkably low rainfall) show that the Vahu rainfall has been almost exactly in the inverse ratio of the relative distances of the two outer stations. Still the evidence, so far as it goes, favours the idea that the forest increases the rainfall."

MARINE METEOROLOGY.—A volume of weather charts of the Bay of Bengal exhibiting the barometric pressure, winds, and currents prevalent in every part of that sea, and as far south as the equator, in each month of the year, has been published during the past year. The work has been prepared by Mr. Dallas from the data furnished by the Meteorological logs collected by the London Meteorological Office during the years 1855 to 1878, and copied, tabulated, and reduced at the cost of the Government of India. The charts, originally drawn on a larger scale, have been reduced to convenient dimensions and printed by the photozincographic process in the Surveyor-General's Office, Calcutta. Each chart is accompanied with a page of description giving some statistical and other details that could not well be represented on the chart.

I have reason to believe that the publication is much appreciated by officers of the mercantile, as well as the naval marine, and steps have been taken to render it known and readily accessible to those most interested, through the agency of the port officers of Calcutta and Rangoon, who have very courteously volunteered their assistance. The port officer of Madras reports that vessels afford very little encouragement in that way, to expect that it will be worth while to make any arrangements with that object at Madras.

Mr. Dallas is now engaged on a similar set of charts of the Arabian Sea. Those for the earlier months are now being printed, and the whole set has been drawn on a large

* Mr. H. C. Hill, Conservator of Forests in the Punjab, writes, "Changa Manga is a compact block of 20,242 acres, of which 8,399 are wooded with planted sissoo (*Dalbergia sissoo*); the remainder is under ordinary scrub. The age of the plantation dates back to 1866-67, but little was done for three years, and the age of the forest may be taken as 16 years. The trees (excepting those in the canal avenue averaging 63 feet) of our best compartments average 50, 51, and 53 feet in height, and all compartments have an average of 40 or more."

"The watering of the forest begins in April and goes on more or less till September. Very little of it ever gets a second watering in the year, but that given is a good soaker of 3 or 4 feet depth of water. The ground to the east and south, except where two rakhs are touched, is all under cultivation and irrigated. Irrigation mostly from June to April."

scale, and are in course of reduction. Their issue may be expected in the course of a few months.

A set of four charts (one for each quarter) illustrating the density and temperature of the sea water of the Bay of Bengal and the adjacent equatorial sea are printed and nearly ready for issue. The collection of weather information from ships visiting the port of Calcutta has been carried on continuously during the last year on the plan devised and organized by Mr. Eliot, and 231 logs, each extending over at least a week or ten days on an average, have been received during the past year. I have little doubt that the publication of the weather charts will bring sea-faring men more into communication with the office, and will stimulate this collection of valuable data.

Rather more than two years ago Mr. Eliot drew up and published in the 2nd volume of the Indian Meteorological Memoirs a very valuable discussion of all the storms that had been known to occur in any part of the Bay of Bengal during the five years 1877—1881. They comprised 46 in all; but, as no systematic collection of meteorological data from ships had been attempted before 1882, almost the only information available for the discussion consisted in the observations of the coast observatories. Nevertheless very much light was thrown on the places of origin, tracks, and frequency of cyclonic storms in the Bay, and the daily weather charts that have been prepared since 1877 for all India enabled their further progress over the land of India to be traced with considerable accuracy.

Mr. Eliot has now resumed this work for the quinquennium 1882—86, for which he has, in addition to the weather charts of the land, all the information contributed by sea-going vessels under the system proposed and organized by him in 1882; and his memoir and the illustrative charts are already well advanced. It is proposed when this work shall have been accomplished, to draw up a hand-book on the subject for the use of seamen, the existing works on the subject, which in default of anything more modern are still appealed to as standards and guides, being very much behind our present state of knowledge, and sometimes seriously misleading on points of importance.

EXTENSION OF STORM SIGNAL SERVICE.—It was reported in the last year's Administration Report that arrangements had been made for extending the storm signal service hitherto restricted to the ports of Calcutta (with its approaches) and Chittagong to other ports on the coasts of the Bay. These arrangements were promptly carried out in Burma and Bengal. As regards Madras, there has been some correspondence with the Local Government, but it does not appear what steps have been taken, if any, to give effect to the proposals of this Department.

HENRY F. BLANFORD,

Meteorological Reporter to the Government of India.

METEOROLOGICAL OFFICE, INDIA;

Simla, the 30th April 1887.

PART II.—DETAILS OF ADMINISTRATION.

OBSERVATORIES.

At the commencement of the year under report, there were 131 observatories in India and elsewhere, contributing original registers to this office. Four new observatories were opened during the year, *viz.* three, Mandalay, Bhamo, and Kindat in Upper Burma, and one on the Cocos Island between the Andamans and Cape Negrais. There has also existed an observatory at Coconada for some years past in connection with the Bengal Storm-warning System, but the registers have not been communicated to the Central Office.

The changes in the observatory at Mussooree are fully described in pages 1 and 2. Thus, at the close of the year, there were 135 observatories working in connection with the department. These are enumerated in the following list, which also specifies the class to which they belonged at the close of the year. The classes are:—

- 1st Class*, furnished with autographic instruments for pressure, temperature, humidity, rainfall and wind registration, either continuously or at short (10 minutes') intervals.
- 2nd Class*, at which hourly observations are recorded on four days in each month; on other days observations are taken 3 times during the day; or observations are recorded daily 4 times at intervals of 6 hours. Certain of these observatories are also furnished with anemographs for the continuous registration of the wind.
- 3rd Class*, at which observations of pressure, temperature, &c., are recorded twice daily, *viz.*, at 10 A.M. and 4 P.M., and measurement of rainfall taken at 6 P.M. Certain of these observatories are also provided with anemographs, and also record an additional set of observations.
- 4th Class*, at which observations of temperature, wind, and rainfall only, are similarly recorded.

BENGAL AND ASSAM.					
	Class.		Class.		Class.
Dhubri . . .	2nd	Darjeeling . . .	3rd	Calcutta (Alipore) .	1st
Tezpur . . .	3rd	Purneah . . .	"	Do, (Chowringhee) .	4
Sibsagar . . .	"	Durbhanga . . .	"	Demagiri . . .	"
Silchar . . .	"	Gya . . .	"	Mongpoo . . .	"
Bankipore (Patna) .	"	Berhampur . . .	"	Tura . . .	"
Hazaribagh . . .	"	Burdwan . . .	"	Pedong . . .	3rd
Saugor Island . . .	2nd	Jessore . . .	"		
Cuttack . . .	3rd	Dacca . . .	"		
Chittagong . . .	"	False Point . . .	"		

NORTH-WESTERN PROVINCES AND OUDH.					
	Class.		Class.		Class.
Allahabad . . .	1st	Mussooree (Surveyor		Meerut . . .	3rd
Agra . . .	3rd	Genl.'s office) .	2nd	Gorakhpur . . .	"
Lucknow . . .	"	Dehra (Surveyor Genl.'s		Ghazipur . . .	"
Roorkee . . .	"	office) . . .	3rd	Benares . . .	"
Chakrata . . .	"	Do. (Forest School) .	4th	Jhansi . . .	"
Ranikhet . . .	"	Bareilly . . .	3rd	Pithoragarh . . .	"

PUNJAB.

	Class.		Class.		Class.
Lahore . . .	2nd	Murree . . .	3rd	Kailang . . .	3rd
Mooltan . . .	3rd	Sialkot . . .	"	Delhi . . .	"
Dera Ismail Khan . . .	"	Ludhiana . . .	"	Sirsa . . .	"
Peshawar . . .	"	Chamba . . .	"		
Rawalpindi . . .	"	Simla . . .	"		

CENTRAL PROVINCES.

	Class.		Class.		Class.
Nagpur . . .	2nd	Hoshangabad . . .	3rd	Sironcha . . .	3rd
Jubbulpore . . .	"	Seoni . . .	"	Raipur . . .	"
Pachmarhi . . .	"	Khandwa . . .	"	Sambalpur . . .	"
Saugor . . .	3rd	Chanda . . .	"		

BERAR.

	Class.		Class.		Class.
Akola . . .	3rd	Chikalda . . .	3rd	Makhla . . .	4th
Buldana . . .	"	Amraoti . . .	"		

CENTRAL INDIA AND RAJPUTANA.

	Class.		Class.		Class.
Jeypore . . .	1st	Indore . . .	3rd	Sambhar . . .	3rd
Sutna . . .	3rd	Mount Abu . . .	"	Bickaneer . . .	"
Nowgong . . .	"	Pachpadra . . .	"		
Neemuch . . .	"	Ajmere . . .	"		

BOMBAY.

	Class.		Class.		Class.
Colaba (Bombay) . . .	1st	Jacobabad . . .	3rd	Baroda . . .	3rd
Belgaum . . .	2nd	Hyderabad (Sind) . . .	"	Surat . . .	"
Poona . . .	"	Bhuj . . .	"	Malegaon . . .	"
Deesa . . .	"	Rajkot . . .	"	Ratnagiri . . .	"
Kurrachee . . .	"	Sholapur . . .	"	Karwar . . .	"

MADRAS.

	Class.		Class.		Class.
Vizagapatam . . .	2nd	Kurnool . . .	3rd	Madura . . .	3rd
Bellary . . .	"	Cuddapah . . .	"	Calicut . . .	"
Trichinopoly . . .	"	Madras . . .	"	Wellington . . .	"
Gopalpur . . .	3rd	Bangalore . . .	"	Mercara . . .	"
Coconada . . .	"	Negapatam . . .	"	Mangalore . . .	"
Masulipatam . . .	"	Salem . . .	"	Rajamundry . . .	"
Secunderabad . . .	"	Coimbatore . . .	"	Cochin . . .	"

BURMA.

	Class.		Class.		Class.
Rangoon . . .	2nd	Kindat . . .	3rd	Mergui . . .	3rd
Bassein . . .	3rd	Bhamo . . .	"	Moulmein . . .	"
Diamond Island . . .	"	Mandalay . . .	"	Toungoo . . .	"
Akyab . . .	"	Thayetmyo . . .	"		

BAY ISLANDS.

	Class.		Class.		Class.
Cocos Island . . .	3rd	Port Blair . . .	3rd	Nancowry . . .	3rd

EXTRA INDIAN.					
	Class.		Class.		Class.
Leh	2nd	Bushire	3rd	Katmandu	3rd
Aden	"	Quetta	"	Amini Divi (Lakha- dives)	"

OBSERVATORIES IN BENGAL AND ASSAM.—*The Alipore Observatory.*—This observatory serves as a general depôt for the verification of instruments, as well as for observations of an experimental character, and an important part of the work is the working of the time signals for the port of Calcutta. It is immediately superintended by the Reporter to the Government of India, and the establishment is under the charge of the Chief Observer, Babu Brojo Mohun Ruckhit, B.A. During the past year the work of the observatory has consisted of—

- 1st.—Continuous registration, by autographic instruments, of (a) the duration of bright sunshine, (b) the atmospheric pressure, (c) temperature, (d) moisture (dry and wet bulb thermometers), (e) wind direction, movement, and pressure, and (f) rainfall.
- 2nd.—Periodical readings, five times daily, of the barometer, dry and wet bulb thermometers, measurements of rain and estimate of cloud proportion, once daily of the maximum and minimum thermometers in the shade, and of the exposed thermometers for nocturnal radiation and insolation, and thrice daily of the ground thermometers at the surface, 1 foot, 3 feet, and once at 6 feet deep. Also occasional observations on the movements of the higher clouds by means of the nephoscope.
- 3rd.—The verification of all thermometers issued to observatories throughout India, with the exception of those under the Meteorological Reporter for Western India, and the comparison of all barometers with the Calcutta standard.
- 4th.—The determination of the mean local time by meridian observations of the sun, and the working of the time signals for the guidance of the shipping in the port. Also, the custody and rating of Government chronometers.

The establishment for the above purposes consists of—

Babu Brojo Mohun Ruckhit, B.A., Chief Observer.
 „ Annada Prasad Banerjee, B.A., 1st Photo. Assistant.
 „ Ram Chandra Chakravarti, 2nd ditto.
 „ Sham Lall Sen, Observer.
 „ Mahindro Nauth Banerjee, Observer.
 2 artificers.
 1 batteryman,
 6 servants.

The autographic instruments consist of a sunshine recorder, a Kew barograph and thermograph, which register by photography, a Beckley's anemograph, and Osler's anemometer, and a Beckley's rain-gauge. During the past year, with but slight exceptions, the instruments have worked well.

The interruptions of the photographic records, though more frequent than is desirable, were due chiefly to the imperfect working of the instruments, and were all of short duration, rarely exceeding one or two hours.

It was mentioned in the report for 1884-85 that, in March 1884, a bubble of air had penetrated the Torricellian vacuum of the barograph barometer-tube, causing a depression of the column and altering the zero value of the instrument. Since then, the barograph trace measurements at the hours of reading the standard barometer have been compared with the eye readings of the latter instrument month by month, and a correction applied

to the former to equalise them to the latter. The results of these comparisons are given in the following table :—

Comparative mean reduced readings of barograph and standard barometer in 1886.

1886.	STANDARD BAROMETER.					BAROGRAPH.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January	30·013	30·087	29·963	30·027	30·023	29·989	30·069	29·935	30·005	29·999
February	29·962	·045	·909	29·975	29·973	·939	·028	·883	29·954	·951
March	·869	29·935	·814	·885	·876	·843	29·916	·784	·861	·851
April	·752	·806	·686	·766	·753	·728	·789	·660	·742	·730
May	·715	·755	·637	·721	·707	·687	·734	·610	·695	·682
June	·552	·586	·497	·577	·553	·519	·563	·464	·546	·523
July	·551	·585	·499	·578	·553	·515	·563	·468	·547	·523
August	·611	·653	·556	·646	·617	·578	·626	·523	·614	·585
September	·687	·735	·637	·719	·695	·652	·710	·602	·688	·663
October	·836	·886	·767	·848	·834	·808	·865	·737	·822	·808
November	·958	30·012	·897	·973	·960	·933	·995	·871	·950	·937
December	30·020	·088	·967	30·042	30·029	·998	30·070	·943	30·021	30·008
YEAR	29·794	29·848	29·736	29·813	29·798	29·766	29·827	29·707	29·787	29·772

The constancy of the standard (Newman's No. 109, with a constant correction of —0·005 to assimilate it to the old Calcutta standard) is verified by series of comparative readings, made at intervals of 6 months, with two other barometers of similar construction (Newman's No. 86 and No. 112). If there has been any change in their relative values since July 1883, it is in a slight depression of the two secondary standards or perhaps in No. 109 only, but this is doubtful.

The following table gives a comparison between the eye readings of the compared and corrected thermometers under the thermometer shed at Alipore, with the corresponding thermograph traces, which shows that the difference of the dry and wet bulbs has apparently increased by 0·1°, but, as the exposure of the instruments is not the same, it may be due to some change in the local conditions affecting the readings.

Comparative mean readings of the thermograph and dry bulb thermometer in the thermometer shed in 1886.

1886.	THERMOMETER IN SHED.					THERMOGRAPH (DRY BULB).				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	°	°	°	°	°	°	°	°	°	°
January	57·5	68·0	75·1	61·4	65·5	58·7	67·0	74·0	62·2	65·5
February	59·4	71·7	80·5	64·0	68·9	60·6	70·4	78·9	65·0	68·7
March	70·6	80·8	86·5	74·1	78·0	71·8	80·0	86·2	75·2	78·3
April	76·4	88·1	93·7	80·4	84·7	77·9	87·9	94·2	81·8	85·5
May	78·5	87·4	89·2	80·6	83·9	79·6	88·2	90·2	81·7	84·9
June	80·7	86·9	87·6	82·1	84·3	81·6	87·9	88·0	83·0	85·1
July	79·8	84·2	83·8	80·8	82·2	80·4	85·1	84·5	81·5	82·9
August	79·5	84·4	84·2	80·5	82·2	80·2	84·8	84·9	81·2	82·8
September	79·0	83·8	83·2	80·1	81·5	79·8	84·3	84·1	80·8	82·3
October	77·6	84·2	84·8	79·0	81·4	78·5	84·0	85·1	79·8	81·9
November	67·9	77·1	80·6	70·4	74·0	69·2	77·0	80·4	71·3	74·5
December	59·4	70·9	76·2	62·9	67·4	60·7	70·0	75·5	64·2	67·6
YEAR	72·2	80·6	83·8	74·7	77·8	73·3	80·6	83·8	75·6	78·3

Comparative mean readings of the thermograph and wet bulb thermometer in the thermometer shed in 1886.

1886.	WET BULB IN SHED.					THERMOGRAPH (WET BULB).				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	°	°	°	°	°	°	°	°	°	°
January	55.9	60.7	62.5	59.0	59.5	56.2	60.5	62.9	59.4	59.8
February	57.2	60.7	61.4	59.9	59.8	57.6	60.6	61.7	60.6	60.1
March	68.4	71.5	70.3	70.5	70.2	69.0	71.8	71.7	71.2	70.9
April	74.0	76.3	74.9	75.5	75.2	74.9	77.2	76.5	76.7	76.3
May	76.3	78.5	78.0	76.6	77.4	77.0	80.0	79.8	77.6	78.6
June	78.8	79.9	79.7	79.0	79.4	79.4	81.1	81.0	79.8	80.3
July	78.3	79.8	79.9	78.5	79.1	78.7	80.6	80.5	79.0	79.7
August	78.1	80.0	79.7	78.5	79.1	78.5	80.5	80.5	78.9	79.6
September	77.8	79.5	79.3	78.5	78.8	78.2	80.2	80.1	78.8	79.3
October	76.7	78.3	77.9	77.4	77.6	77.0	78.6	78.8	77.8	78.1
November	66.0	69.0	69.6	67.9	68.1	66.5	69.2	70.0	68.5	68.6
December	57.9	63.3	64.2	60.8	61.6	58.1	63.0	63.9	61.2	61.6
YEAR	70.5	73.1	73.1	71.8	72.2	70.9	73.6	74.0	72.5	72.7

The sunshine recorder has continued to work satisfactorily. The observations of ground temperature have been carried on, as in the previous year. An abstract of the registers is given in the report on the Meteorology of India in the year 1886.

The number of instruments verified at the Alipore Observatory, during the year ending 31st March 1887, is given below. Excepting aneroid barometers, solar and nocturnal radiation thermometers, rain-gauges, and measure-glasses, the number is considerably higher than in the previous year :—

Instruments.	No.
Barometers	52
Aneroids	10
Dry and wet bulb thermometers	62
Maximum thermometers for air temperature	46
Minimum do. do. do.	55
Do. do. for nocturnal radiation	18
Solar radiation thermometers	20
Boiling point do.	6
Sling do.	2
Standard do.	1
Rain-gauges	4
Measure-glasses for rain-gauges	4
TOTAL	280

The following is a return of the instruments received and issued by the observatory. The instrument store is now attached to the Calcutta Meteorological Office:—

Instruments.										Received.	Issued.
Barometers	.	.	.	.	.	.	.	.	.	60	42
Aneroids	.	.	.	.	.	.	.	.	.	12	13
Dry and wet bulb thermometers	.	.	.	.	.	.	.	.	.	93	66
Maximum thermometers for air temperature	.	.	.	.	.	.	.	.	.	39	47
Minimum	do.	do.	do.	.	.	.	.	.	.	77	67
Do.	do.	do.	for nocturnal radiation	.	.	.	.	.	.	30	20
Solar radiation thermometers	.	.	.	.	.	.	.	.	.	33	18
Standard	do.	.	.	.	.	.	.	.	.	5	2
Common	do.	.	.	.	.	.	.	.	.	0	1
Six's	do.	.	.	.	.	.	.	.	.	1	0
Boiling point	do.	.	.	.	.	.	.	.	.	6	6
Sling	do.	.	.	.	.	.	.	.	.	14	3
Traveller's maximum and minimum thermometers, in pairs	.	.	.	.	.	.	.	.	.	2	2
Hypsometer	.	.	.	.	.	.	.	.	.	1	1
Rain-gauges	.	.	.	.	.	.	.	.	.	4	4
Anemometer	.	.	.	.	.	.	.	.	.	1	1
Wind vane	.	.	.	.	.	.	.	.	.	1	1
Measure-glasses for rain-gauges	.	.	.	.	.	.	.	.	.	4	4
TOTAL										383	298

The time signals have worked satisfactorily throughout the year.

During the official year 1886-87 the two time balls were dropped, on working days only, till 31st July. But from 1st August they were dropped on all days, Sundays and holidays inclusive. Of the 122 days from 1st April to 31st July 1886, both time balls dropped correctly on 80 days, on 11 days the time ball trigger at the Port Commissioners' Office was under repair, on 9 days one or the other of the two balls either failed altogether or dropped inaccurately, and the remaining 22 days were either Sundays or holidays. Again, of the 243 days, from 1st August 1886 to 31st March 1887, both time balls dropped correctly on 239 days, and on 4 days one or the other of the two balls failed to give the signal accurately.

Table showing the occasions of failure of the two time balls during the official year 1886-87.

Dates of failures.	Number of failure.
21st April 1886	Time ball at the Port Commissioners' Office doubtful.
22nd " "	Do. do. do. failed altogether.
27th " "	Do. do. do. do.
3rd May " "	Do. do. do. do.
4th to 14th May 1886	Do. do. do. under repair.
20th May 1886	Do. do. do. dropped a few seconds late.
22nd " "	Do. on the Semaphore tower, Fort William, dropped a few seconds late.
9th June " "	Do. at the Port Commissioners' Office failed altogether.
23rd July " "	Do. do. do. do.
26th " "	Do. on the Semaphore tower, Fort William, dropped a few seconds late.
17th August 1886	Do. on the Semaphore tower, Fort William, dropped a few seconds late.
19th " "	Do. on the Semaphore tower, Fort William, dropped a few seconds late.
3rd February 1887	Do. at the Port Commissioners' Office doubtful.
18th " "	Do. on the Semaphore tower, Fort William, dropped a few seconds late.

OTHER OBSERVATORIES IN BENGAL AND ASSAM.—A list of the observatories reporting to the office of the Imperial Government has been given at page 16. Mongpoo and Pedong are immediately under the Imperial Office, the remainder under the Meteorological Reporter to the Government of Bengal. Those reporting only to the Provincial Office are enumerated below in a foot-note.*

Some extracts from Mr. Pedler's report, on the condition and working of the observatories under his charge, are given in Appendix A. Of the observatories on the Imperial list, twelve (exclusive of the two Calcutta observatories) have been inspected during the year, *viz.*, Burdwan by Mr. Pedler, Dacca, Cachar, Dhubri, Sibsagar, Tezpur and Purneah by Mr. Dallas, Bankipore (Patna), Gya, Durbhanga, Dacca and Darjeeling by myself, and Bankipore (Patna) and Berhampore by the Head Clerk of the Bengal Office.

It will thus be seen that a large number of the stations have been inspected this year. Two of them had to be inspected twice, either because of unsatisfactory readings, or that the condition of the observatory required a second visit.

Dhubri Observatory was visited on the 9th, 10th, and 11th August 1886 by Mr. Dallas, Assistant Meteorological Reporter to the Government of India. In accordance with the decision come to last year as the result of the inspection of this observatory, Munshi Kadimuddin Ahmed, who was found to be unfit for the duties of the Head observer, was dismissed on the 23rd August 1886. His place was filled from August 24th by Babu Baidya Nath Banerji, who received a course of practical training at the Alipore Observatory in the use of the several instruments, and in the Meteorological Office in the work of preparation of the various registers. During the visit of Mr. Dallas the old observer continued to hold office. The condition of the observatory was then not very satisfactory. Mr. Dallas reported—"There was a bad leakage in the roof of the Casella tower. On the morning of the 10th, the water was pouring on the clock-work of the anemometer, and will, if not stopped, eventually ruin it." The leakage was at once stopped by the District Engineer, but the Superintendent has reported that, with the setting in of the rains in the year 1886-87, it has again appeared. Unless the anemograph house can be effectually repaired, it will be impossible to keep the self-recording Casella's anemograph in working order. Owing to this cause there have been several breaks in the traces of the anemograph during the year, and the instrument has not been working very satisfactorily. It is hoped that this observatory will materially improve under the care of the new observer and of the paid Superintendent. The returns during the year have been received punctually, and have been found generally correct.

Saugor Island was not visited during the year. The observatory has, however, worked very satisfactorily. Fortin's barometer, No. 1315, which was in use since 15th March 1885, was reported to leak badly on the 31st May 1886. Newman's marine barometer belonging to the light-house was used from that date till the 19th June 1886, when Fortin's barometer, No. 626, was brought into use. A set of comparative readings was taken with the marine barometer and the Fortin's standard supplied, in order that the readings reported from the former might be reduced to the Indian standard. A carefully compared aneroid

* The observatories established for the system of daily local report in Bengal are the following :—

Balasore.	Furreedpore.	Bhagalpore.	Nya Doomka.
Midnapore.	Mymensing.	Chupra.	Ranchee.
Raneegunge.	Rampore Bauleah.	Motiharee.	Chybassa.
Noakholly.	Dinagepore.	Buxar.	Bogra.
Burrisal.	Rungpore.	Arrah.	Maldah.
Serajganj.	Bankoora.	Krishnagar.	
Commillah.	Julpigoree.	Dehree.	

barometer, No. 1773, has also been supplied to the observatory to serve as a spare instrument in cases of sudden breakage or injury to the instrument in use. The anemograph at Saugor Island, which is one of Beckley's pattern, has worked satisfactorily throughout the year, and there have been no breaks. Mr. Peters, the Observer, has worked very well, and has done good service during stormy weather in reporting the additional observations required.

Berhampore, Burdwan, Darjeeling, Durbhanga, Dacca, Patna, Purneah, Sibsagar, and Silchar were all found on inspection to be in excellent order. The Gya Observatory has improved very considerably under a new observer.

The new observatory of the 3rd class established at Tezpur in Assam in 1885 was inspected by Mr. Dallas, and found to be in an unsatisfactory condition. Several changes were made, and it is now working better and sending in fairly accurate observations.

Of the observatories that were not inspected during the year, Mr. Pedler speaks very favourably of Chittagong, Hazaribagh, False Point, Gopalpur, and Coconada. Jessore and Tura have improved very considerably.

The Cuttack Observatory, under the Telegraph Master, Mr. Stone, was in a very inefficient state, and either through his carelessness or want of knowledge, many instrumental readings have had to be rejected during the course of the year. The anemograph was also allowed to get out of order from want of attention. Mr. Stone has now been transferred from Cuttack.

At Hazaribagh, Cuttack, Darjeeling, Saugor Island, and Chittagong, the self-recording anemographs have been kept up as hitherto. At the first two stations, Casella's pattern instruments are used, and at the third, fourth, and fifth, Beckley's instruments. The records were most complete in the case of Hazaribagh and Chittagong. At the former there was a short break of 17 hours only during the year, for cleaning.

The Chittagong observer, writing under date the 26th February 1887, reported that "during a severe nor'wester at 4 A.M. this morning, which was accompanied with thunder-storm and hail, a large piece of heavy bamboo matting from an adjoining roof was thrown against the anemograph structure on the office roof, bringing down the whole of the exposed machinery. The cups, rods, and the wind vanes have been bent and broken." These were repaired locally, and the instrument again began to work from the 1st March 1887 from 2 P.M. There was therefore a break from 26th February to 1st March.

At Cuttack there have been several breaks in the anemograph traces. These were apparently due to want of attention on the part of the Telegraph Master, Mr. Stone.

At Darjeeling the anemograph traces have not been so continuous as could be desired, but this has been due to a great extent to the fact that the anemograph is not a very satisfactory one. Mr. Carter the Superintendent, and the Observer, have worked hard to try to obtain more distinct traces, but they have unfortunately not been very successful.

A list of the Superintendents and Observers is given in Appendix C.

Special allowances have been granted for the present year to the observers enumerated as follows:—

Names.	Stations.	Amounts. R
Makhada Prosad Chowdhuri . . .	Burdwan . . .	10
Mahendra Nath Roy . . .	Berhampore . . .	10
Danda Dhar Datta Barua . . .	Sibsagar . . .	10
Paresh Nath Roy Chowdhuri . . .	Jessore . . .	5
Nathu Lall . . .	Hazaribagh . . .	5
Ramesh Chunder Bhuddra . . .	Silchar . . .	5
Jogin Chunder Banerjee . . .	Durbhanga . . .	5
R. H. Peters . . .	Saugor Island . . .	5

OBSERVATORIES IN THE NORTH-WESTERN PROVINCES AND OUDH.—The first class observatory at Allahabad is situated in a new building specially constructed for it in the Chatham lines, and furnished with a meteorograph which records autographically. It has, however, worked unsatisfactorily during the year in consequence of defects in the instrument, and it has been found necessary to return it to the maker for thorough repair. Meanwhile the staff of observers will take on two days in every week, in addition to the readings of the ordinary instruments recorded by eye at intervals from 5h. 50m. A.M. up to 10 P.M., hourly observations of wind and cloud and of the temperature and humidity of the air at two heights above the ground differing by 40 feet, as well as under the thatched shed at a height of 4 feet.

Previously to September 1884 the observatory was at the Muir College. As the removal of an observatory always introduces some change in the normal or average temperature, humidity, &c., no two sites being exactly alike in these respects, and as it is a matter of great importance that the registers of any future years shall be rigorously comparable with those of past years, observations have been made simultaneously, twice a day, at the new and old observatories, since the beginning of September 1884, and were continued for two complete years. In the extracts from his Administration Report (Appendix B) Mr. Hill notices the differences which have thus become apparent in the effects of the two sites on the instruments, and traces them to their probable causes. His tables and remarks are given *in extenso* in Appendix B.

The establishment of the Allahabad Observatory consists of—

Babu Kadar Nath Chatterjee, Head Observer.		
„	Sashibhusun Banerjee, Second	do.
„	Jadu Nath Chatterjee, Third	do.
1	electrician occasionally and casually.	
1	artificer	do. do.
1	printer	do. do.
and 4 menial servants.		

The work of the observatory consists of—

1st.—Registering autographically, at intervals of 10 minutes, by means of a Van Rysselberghe meteorograph, the readings of the barometer, dry and wet bulb thermometers, direction and amount of the wind, and the rainfall. The register is engraved on a prepared metallic plate, which is afterwards etched, and from which any required number of copies can be printed off.

2nd.—Periodic readings, five times daily, of the barometer, dry and wet bulb thermometers, &c., &c., and once daily of maximum and minimum air temperature and the radiation thermometers, and thrice daily of the ground thermometers at the surface, 1 foot, 3 feet and 9 feet deep, &c., as at the Alipore Observatory. Also the registering of the duration of bright sunshine, and observations on the movements of the higher clouds with a Marie Davy nephoscope.

The new observatory accommodates the Meteorological Reporter's Office, as well as the observatory establishment.

The three observatories of Lucknow, Agra, and Roorkee, which were 2nd class observatories until the end of 1885, have furnished during the past year the same observations as 3rd class stations, with the addition of synoptic observations as a part of the international system in correspondence with the United States Meteorological Department, and which it is intended to continue indefinitely.

In June and July 1885 the observatory at Lucknow was, in part, transferred to a different but neighbouring building, the Farhat Baksh. The change, thus introduced, really, however, affects only the wind registers, the anemograph having been set up on the roof of the present building. The barometer in a lower room, is at exactly the same elevation as formerly, and the thermometer shed and instruments have not been moved. The observatory was inspected by Mr. Hill in June 1886, and everything found to be in a satisfactory condition.

The Roorkee Observatory was visited by Mr. Hill in June 1886, and everything was found in good order, except that the thermometer for nocturnal radiation was placed on the top of a small mound, and that the minimum thermometer in shade had a considerable quantity of spirit collected at the top of the tube. These defects were rectified at the time of inspection.

The Agra Observatory was visited by Mr. Hill in December 1886, and found to be in very good order. The chief instruments were reverified.

Mr. Hill has also inspected Bareilly, Gorakhpur, Ghazipore, and Chakrata once, and the Benares Observatory on more than one occasion. The Observatory of Benares was found to be in excellent order; the others somewhat less so. The old observer at Jhansi retired during the past year, and was succeeded by a more intelligent and careful observer. At Ranikhet and Pithoragarh, the observers on the whole worked well.

The old observatory at Dehra is attached to the Office of the Survey of India by whom it is maintained. It was visited by Mr. Hill in June 1886, when he found all the instruments in good order. The only improvements in the practice of the observatory that could be suggested would be to remove the barometer from the thermometer shed to the interior of the building, and to take away the lattice work round the shed, which probably reduces to a considerable extent the true range of temperature. In addition to the ordinary meteorological instruments, this station possesses an anemograph (Beckley's), a sunshine recorder, and a set of earth thermometers going to various depths down to 25·6 feet. The holes in which these instruments are placed being much wider than the thermometer rods, the temperatures indicated are probably to some extent affected by convection currents.

At Dehra, there is another observatory, attached to the Forest School, where observations of temperature and humidity are made under a thatched shed of the standard pattern, and under a somewhat similar, though smaller, shed at the top of a scaffolding, 60 feet high. In other parts of the district, the Forest Department have made arrangements for taking comparative temperatures in the forest and on the open plain adjoining. At the time of Mr. Hill's visit all the instruments at the Forest School seemed in good order, but rather dirty, and the mercury in the barometer cistern was oxidised. This was taken out and cleaned.

On the same tour of inspection Mr. Hill also visited an observatory at the summer quarters of the Trigonometrical Survey in Mussooree. This has hitherto been kept up only during six months in the year; but, as actinometric observations will now be made under the direction of Colonel Haig whenever opportunity offers, in the cold season as well as the hot, the ordinary meteorological observations will now be carried on continuously. The instruments, including a Beckley's anemograph, appeared to be all in good order.

A list of the Superintendents and Observers is given in Appendix C.

Special meritorious allowances have been conferred on the following observers for the ensuing year:—

Names.	Stations.	Amounts. R
Chotay Lall	Lucknow	10
Jewa Nand	Ranikhet	10
Chiranje Lall	Roorkee	10
Mir Altaf Ali	Agra	5
Sher Shingh	Pithoragarh	5

OBSERVATORIES IN THE PUNJAB.—The observatories in this province are the same in number and position as in the previous year, and are enumerated on page 17. Chamba and Kailang are immediately under the Imperial Office, the remainder under the Meteorological Reporter for the Punjab.

The Lahore Observatory still awaits the arrival of some of the autographic instruments, required for its outfit as an observatory of the first class. A self-registering rain-gauge and a Beckley's anemograph have been received. The tower for the Beckley anemometer is as yet uncommenced. The automatic rain-gauge, however, which was received in the observatory on the 12th of May 1886 has been set up in working order. The receiving funnel is on the roof of the observatory at a height of 24 feet above the ground. It is connected by a brass tube to the recording apparatus, which has been placed in a room of the Meteorological Office. Since its erection there has been no rain at Lahore, but experiments show that the instrument registers correctly. Another automatic instrument received is the sun thermometer. This instrument arrived at the observatory on the 2nd of May 1887, and immediately on receiving news of its arrival, the Officiating Superintendent of the Observatory was asked to select a suitable site for the instrument, and to request the Public Works Department, Punjab, to carry out any alterations which its erection may necessitate. The remaining automatic instruments are now on their way to India, and in the course of the current year it is hoped that Lahore will receive its full equipment of self-registering instruments, and be raised to a first class observatory.

Meanwhile, the observatory is carried on as second class, hourly observations being recorded on four days in each month. In addition to the observations made at other observatories of the same class, a register is kept of the ground temperature, from the surface down to 6 feet below it, and also of the duration of bright sunshine by means of a sunshine recorder.

A duplicate set of observations (on the scale of a 3rd class station) were taken for two years until December 1886 at the old observatory at the Mayo Hospital, in order to determine the effect of the change of site on the normal readings of the chief instruments. The following table gives the corrections as derived from a comparison of the observations of the two complete years:—

MONTHS.	DRY BULB.			WET BULB.			MAXIMUM.			MINIMUM.			SOLAR RADIATION THERMOMETER.			NOCTURNAL RADIATION THERMOMETER.		
	New.	Old.	Diff.	New.	Old.	Diff.	New.	Old.	Diff.	New.	Old.	Diff.	New.	Old.	Diff.	New.	Old.	Diff.
January 1885	58.0	58.6	-0.6	52.0	52.3	-0.3	63.5	64.3	-0.8	43.3	45.4	-2.1	106.5	111.6	-5.1	34.3	39.1	-4.8
February "	62.7	62.6	+0.1	50.8	51.7	-0.9	68.2	68.8	-0.6	40.5	43.2	-2.7	132.5	128.5	+4.0	30.2	36.1	-5.9
March "	79.2	79.3	-0.1	62.9	62.5	+0.4	85.0	85.5	-0.5	55.4	57.3	-1.9	150.3	144.2	+6.1	46.8	50.4	-3.6
April "	85.2	85.4	-0.2	66.6	67.3	-0.7	90.7	91.1	-0.4	63.1	65.6	-2.5	157.2	153.6	+3.6	55.7	59.4	-3.7
May "	85.6	86.2	-0.6	69.3	70.2	-0.9	90.9	91.1	-1.1	66.6	68.6	-2.0	152.8	151.8	+1.0	59.9	62.9	-3.0
June "	100.5	101.4	-0.9	76.8	76.2	+0.6	105.8	106.9	-1.1	77.4	79.4	-2.0	165.0	164.1	+0.9	70.2	72.1	-1.9
July "	95.9	96.5	-0.6	80.4	80.2	+0.2	101.3	101.4	-0.1	80.0	81.0	-1.0	160.1	157.9	+2.2	76.7	77.4	-0.7
August "	92.6	93.7	-1.1	80.3	80.7	-0.4	98.3	99.3	-1.0	80.8	80.8	-0.8	162.5	158.4	+4.1	76.2	77.0	-0.8
September "	92.7	93.0	-0.3	74.9	75.5	-0.6	98.1	98.6	-0.5	72.3	74.4	-2.1	157.2	154.9	+2.3	66.7	68.2	-1.5
October "	88.2	88.6	-0.4	68.6	69.7	-1.1	95.3	95.6	-0.3	60.2	62.8	-2.6	152.1	151.5	+0.6	51.1	54.0	-2.9
November "	77.4	77.5	-0.1	60.0	61.1	-1.1	85.2	85.4	-0.2	48.1	50.8	-2.7	140.4	137.9	+2.5	38.3	41.7	-3.4
December "	64.0	64.3	-0.3	55.0	55.6	-0.6	70.6	71.5	-0.9	44.3	46.1	-1.8	125.5	122.1	+3.4	35.7	38.5	-2.8

MONTHS.	DRY BULB.			WET BULB.			MAXIMUM.			MINIMUM.			SOLAR RADIATION THERMOMETER.			NOCTURNAL RADIATION THERMOMETER.		
	New.	Old.	Diff.	New.	Old.	Diff.	New.	Old.	Diff.	New.	Old.	Diff.	New.	Old.	Diff.	New.	Old.	Diff.
January 1886	58.5	58.8	-0.3	52.9	53.1	-0.2	63.8	63.8	0.0	43.9	45.5	-1.6	116.6	115.4	+1.2	36.9	38.8	-1.9
February "	62.2	62.0	+0.2	50.7	51.4	-0.7	68.0	67.9	+0.1	42.9	45.1	-2.2	132.4	127.5	+4.9	34.2	37.4	-3.2
March "	73.0	73.0	0.0	61.8	62.0	-0.2	77.0	77.5	-0.5	54.9	57.0	-2.1	142.1	135.2	+6.9	48.4	51.4	-3.0
April "	89.6	89.1	+0.5	66.8	67.0	-0.2	95.1	94.5	+0.6	62.6	65.9	-3.3	159.3	153.6	+5.7	53.1	58.5	-5.4
May "	96.8	96.9	-0.1	71.3	73.2	-1.9	101.8	101.9	-0.1	71.5	73.6	-2.1	163.7	159.8	+3.9	63.2	66.9	-3.7
June "	97.2	97.7	-0.5	76.2	78.0	-1.8	102.3	102.6	-0.3	79.1	80.3	-1.2	161.5	157.5	+4.0	74.1	75.0	-0.9
July "	89.9	90.3	-0.4	80.8	81.5	-0.7	94.2	94.1	+0.1	79.6	80.1	-0.5	158.9	153.0	+5.9	77.7	77.8	-0.1
August "	92.0	92.1	-0.1	80.3	80.9	-0.6	96.9	96.4	+0.5	78.7	79.1	-0.4	160.8	154.3	+6.5	75.6	76.1	-0.5
September "	95.4	95.1	+0.3	76.6	77.7	-1.1	100.8	100.7	+0.1	74.3	75.9	-1.6	162.0	157.4	+4.6	68.0	70.7	-2.7
October "	85.6	84.8	+0.8	69.0	69.9	-0.9	91.5	90.9	+0.6	61.3	63.2	-1.9	152.9	147.8	+5.1	53.3	56.0	-2.7
November "	75.3	75.3	0.0	61.8	63.1	-1.3	82.1	82.6	-0.5	48.7	51.3	-2.6	141.2	136.7	+4.5	38.5	42.2	-3.7
December "	65.2	65.3	-0.1	53.8	55.5	-1.7	72.5	72.5	-0.2	41.4	44.3	-2.9	130.1	126.9*	+3.2	31.5	34.8	-3.3

* Mean for 15 days.

It will be seen from this table that the temperature at the new observatory near the Central Jail, both at 10 A.M., at the hottest part of the day, and in the early morning, is lower than that at the old observatory near the Mayo Hospital, but that, on the contrary, the heating power of the sun as measured by the solar radiation thermometer is greater at the new than at the old observatory, the increase being attributable to the greater purity of the atmosphere in the former situation.

Mr. Dallas inspected all the observatories in the Punjab except those at Peshawar, Murree, and Rawalpindi. All were in good working order except that at Dera Ismail Khan, where the instruments were rather dirty, and gave evidence of want of care and attention on the part of the observer. Ludhiana was reported upon much more favourably than in previous years. The only instrument that was out of order was the rain-gauge which was found to be quite unserviceable, and was replaced by another.

Mooltan continues to work satisfactorily, and was in excellent order at the time of inspection. At Dera Ismail Khan, the barometer was clean and in good order, but the thermometers were very dirty. The anemometer and wind vane were also found to work very stiffly. The instruments were thoroughly cleaned during Mr. Dallas's visit, and left in good working order. The same condition of affairs was found in a previous inspection, and it will probably be found necessary to inflict severe fines on those observers who are found on inspection to systematically neglect keeping their instruments clean. Sialkot and Sirsa were all in capital condition when inspected, and call for no special remarks. At Delhi the thermometers were not quite so clean as they should have been, and the observer was cautioned.

Rawalpindi was inspected by Mr. Blanford in October 1886. A careful comparison was made of the barometers, and the correction of the two in use at this observatory determined. The shade thermometers were all clean and in good order. The solar radiation thermometer was found to have a portion of the mercury separated and lodged at the upper end. The wind vane and anemometer were both condemned, and shortly afterwards replaced by accurate instruments.

The Chamba Observatory was inspected by Mr. Blanford in November 1886. The barometer in use was found to have a small amount of air in the upper portion of the tube, and it was therefore replaced by another instrument which had been sent shortly before by the India Meteorological Office, and which on examination was found to be in perfect order. The thermometers, wind vane, and rain-gauge were all in excellent condition. The anemometer did not work properly, as it had been shortly before repaired by a local smith. Another instrument was sent after the inspection visit to replace this defective instrument.

The Kailang Observatory has, as usual, been carried on with the greatest care and attention by the Superintendent, the Reverend A. W. Heyde. In addition to the usual registers, Mr. Heyde contributed, as in previous years, most valuable information respecting the climate and variations of the snowfall.

A list of Superintendents and Observers is given in Appendix C.

Special meritorious allowances have been awarded to the following observers for the ensuing year :—

Names.	Stations.	Amounts.
		R
Jaspat Rai	Lahore	10
Devan Chand	Do.	5
Kashi Ram	Peshawar	5
W. Cruikshank	Murree	5
Sergeant J. J. König	Simla	5

OBSERVATORIES IN THE CENTRAL PROVINCES.—The observatories remained the same as last year, but, in consequence of the absence on leave of the observer, the observatory at Sironcha was closed from the 21st November 1886, and remained closed till the end of the year.

During the year, the observatories at Nagpur, Khandwa, Hoshangabad, Saugor, and Jubbulpore were inspected by the Sanitary Commissioner.

The Nagpur Observatory was found to be in good repair, and the instruments in capital order. The sunshine recorder received in 1885 has not yet been brought into use owing to a suitable position for it not having been obtained.

At Khandwa, the shed and instruments were found at the time of inspection to be in good order. The observer reads the instruments carefully.

At Hoshangabad, the buildings were in good repair, and the instruments clean and in good order, with the exception of the anemometer and wind vane, neither of which worked as freely as they should.

At Saugor, the buildings were found to be in good condition, the railings enclosing the shed having been repaired. The instruments were also in a satisfactory state.

The Jubbulpore Observatory was generally in good condition. The anemograph worked unsatisfactorily in 1885 and was sent to Calcutta in April of that year to be repaired, and has not yet been returned. The observer has improved, and does his work somewhat more carefully and correctly than hitherto.

Pachmarhi, which was in an unsatisfactory state during the previous year, went from bad to worse, and the observer was found at last to be so utterly worthless and untrustworthy that it was decided at the end of the year to reduce the observatory from second to third class, to dismiss the observer, and put in the assistant as observer under the altered conditions of the observatory.

A new shed is being erected at Raipur, and was nearly completed at the close of the year.

The thatch of the shed at Sironcha and the railings enclosing the shed at Chanda were repaired during the year.

A list of the Superintendents and Observers is given in Appendix C.

Special allowances have been awarded to the following observers in the Central Provinces for the ensuing year :—

Names.	Stations.	Amounts. R
Seetaram	Chanda	5
Puncham	Seoni	5
P. Soobiah	Nagpur	5
Jodu Nath Basu	Saugor	5

OBSERVATORIES IN BERAR.—These are five in number, the same as last year, and are enumerated on page 17. One of them, Makhla, a 4th class observatory established and carried on by the Forest Department, sends its registers direct to the Imperial Office, and the remaining four are under the Meteorological Reporter for Western India.

None of these observatories were inspected during the year. So far as the examination of the observations sent in by the observing stations indicate, they are in satisfactory condition.

A nominal list of Superintendents and Observers at the Berar stations is given in Appendix C.

The following observers have been re-allotted special allowances during the current year:—

Names.	Stations.	Amounts. R
Samuel Gregory	Akola	10
Bukaram Pandurang	Amraoti	5

OBSERVATORIES IN CENTRAL INDIA AND RAJPUTANA.—These are the same as in previous years, and are enumerated on page 17. The Maharajah's observatory at Jeypore, which is a first-class observatory, sends its registers to the Meteorological Reporter to the Government of the North-Western Provinces and Oudh. A brief description of the work done at that observatory, taken from Mr. Hill's report, will be found in Appendix B.

Of the remaining observatories, those of Nowgong, Sutna, Ajmere, and Sambhar are under the Meteorological Reporter for the North-Western Provinces and Oudh. Those of Neemuch, Indore, Mount Abu, and Bickaneer report to the Meteorological Reporter for Western India, and that of Pachpadra sends its registers direct to the Central Office.

The observatories of Neemuch and Indore were inspected by Mr. Chambers, Meteorological Reporter for Western India in March 1887; Sutna by Mr. Hill, Meteorological Reporter to the Government of North-Western Provinces and Oudh, in September 1886, and Ajmere by Mr. Blanford in November 1886.

The Indore Observatory was found by Mr. Chambers to be in an unsatisfactory state. The situation of the observatory is by no means suitable. The thermometers were clean and in good order. The barometer was in working order, but very dirty. The instrument was thoroughly cleaned and left in good order. The post carrying the flag for indicating the wind direction was removed to a tree, as it obstructed the anemometer. The observer generally read the instruments carefully.

The Neemuch Observatory was less favourably reported upon than on the previous inspection. The exposure of the wind vane and anemometer was, on the whole, very good. The barometer was, in consequence of some slight defects, replaced by another instrument. The thermometers were not in good order. The porcelain scale of the dry bulb was broken, and there was a thin encrustation on the two wet bulbs. The outer bulb of the sun thermometer was dirty, and the instructions for recording the readings of that instrument were not properly carried out. The office records were also found to be very defective and badly kept.

The Sutna Observatory was found by Mr. Hill in fairly good condition. The barometer was very dirty, but was cleaned.

Mr. Blanford inspected the Ajmere Observatory when he found that it would be unnecessary to change the site of the observatory, as had been suggested by Mr. Dallas the previous year. The present thermometer shed is reported to be no longer serviceable, and a new one must be built this year. The work done by the Ajmere Observer during the year has frequently shown signs of carelessness, and his special allowance of Rs 5 per month has in consequence been stopped.

The observatories at Nowgong, Pachpadra, Sambhar, Mount Abu, and Bickaneer have not been inspected during the past year. The first is efficiently supervised, and the others, so far as can be judged from the registers, are working fairly.

A list of the Superintendents and Observers is given in Appendix C.

Special allowances have been re-allotted to the following observers in Rajputana and Central India during the present year:—

Names.	Stations.	Amounts. R
Harnath	Sutna	10
Trimbak Rao	Indore	5

OBSERVATORIES IN BOMBAY.—These, excepting the Colaba Observatory, are all under the Meteorological Reporter for Western India.

Of the four 2nd class observatories, Deesa, Poona, and Belgaum were inspected by Mr. Chambers. He also visited the 3rd class observatories of Rajkot, Sholapur, Ratnagiri, and the voluntary observatory at Baroda.

The Deesa Observatory was generally in an efficient state when inspected. The instruments were all in good order, except the anemograph. The friction roller which supports the vane shafts was working stiffly, due to the oil having dried and caked with dust into a substance resembling India-rubber rather than a lubricant. The instrument was carefully cleaned and re-adjusted. In all other respects the observatory was in a satisfactory condition.

The Poona Observatory was found to be at the time of inspection in good order. The barometer and thermometers were all clean, with the exception of the solar radiation thermometer, which was very dirty. The anemometer was not very clean and worked stiffly in consequence of not being oiled occasionally. This is a frequent fault of omission on the part of observers.

The Belgaum Observatory is stated by Mr. Chambers to be in an unusually open position, and the exposure of the instruments, more specially the anemograph, is exceptionally good. The barometer appeared to have deteriorated to some extent, and hence it was replaced by another instrument. The thermometers were all in good order. The anemograph was thoroughly over-hauled, and some slight defects remedied.

The Rajkot Observatory is in a very open and favourable position. The barometer was in very fair working order, and the thermometers very clean. The anemometer, wind vane, and raingauge were also in satisfactory order. There was no fence round the raingauge and radiation thermometers. This was due to the previous observer having misappropriated the money that was sanctioned and advanced for a new fence. He was imprisoned for two years for the offence.

The Sholapur Observatory was in good order. The barometer was dirty and required thorough cleaning. The thermometers were all clean, and the observer read all the instruments quite correctly.

The Ratnagiri Observatory is at the Civil Hospital on elevated ground overlooking the town. In the opposite direction, the ground rises slightly and then stretches far away into the interior, forming an almost unbroken plain. The surface consists almost entirely of laterite, and is almost devoid of vegetation. The nature of the surface probably accounts for the very high temperatures recorded at Ratnagiri in the dry season. The barometers and thermometers were all found to be in very good order. The anemograph was taken to pieces, cleaned, and re-adjusted. The instrument works well, except in very wet weather, when the paper ribbon becomes too damp and fails to pass between the embossing rollers.

The observations recorded at Jacobabad, Hyderabad, Kurrachee, Bhuj, Deesa, Surat, Malegaon, Poona, Sholapur, Ratnagiri, Belgaum, and Karwar were, in Mr. Chambers' opinion, thoroughly trustworthy throughout the year. Those recorded at Rajkot, however, were frequently doubtful on account of the inexperience of the youth who, in the absence of a more competent person, was appointed to the observership.

The large Beckley's anemograph at Deesa has produced continuous records throughout the year, with the exception of the two days from the 12th to the 14th March, when the instrument was being dismantled, thoroughly cleaned, and re-adjusted. That at Belgaum has, for various reasons, chiefly oversight in management, failed to give traces on seven days, on two of which it was dismantled for cleaning and re-adjustment; on all other days the traces are continuous. The embossing anemograph at Poona has failed to produce records on only three days, on one of which the instrument was being cleaned and re-adjusted. The similar instrument at Ratnagiri has, however, failed on seventeen days, chiefly days of heavy rainfall, when the recording strip of paper became so damp and weak as to tear while passing between the embossing rollers.

A list of the Superintendents and Observers in Bombay is given in Appendix C.

The following special allowances have been awarded for the present year to observers in the Bombay Presidency—

Names.	Stations.	Amounts.
		R
Mahadev Cuddum	Ratnagiri	10
Ramkrishna K. Karandikar	Deesa	5
Narayan Sakaram	Poona	5
G. W. M. D. Aranjo	Karwar	5
Ramchundra Datta	Belgaum	5
Mingue Fernandez	Kurrachee	5
Shaik Ali	Jacobabad	5
Shaik Mahomed	Malegaon	5

OBSERVATORIES IN MADRAS, MYSORE, AND HYDERABAD.—Of the 21 observatories in these provinces enumerated in the list on page 17, all but five, *viz.*, the Madras Observatory and those of Gopalpore, Vizagapatam, Coconada, and Calicut, are under the control of Miss Pogson as Meteorological Reporter to the Government of Madras. Thirteen of the sixteen have been inspected during the year, *viz.*, nine by Miss Pogson, one by the Meteorological Reporter for Western India, and three by the Head Clerk of the Madras Meteorological Office.

Bangalore was inspected by Miss Pogson on the 26th November and on several subsequent occasions. The instruments were all found to be in good order. It was necessary to remove the observatory to a new site during the year, and a suitable position was obtained in a piece of open ground belonging to the police, forming a small portion of their parade ground. A new shed was erected, and the instruments were removed to it on 6th December. A site just outside the parade ground was also selected for a small barometer room, but the erection of the building has been delayed from various causes.

There have been several changes at the Bellary Observatory during the year, and it has hence been in a less satisfactory condition than in previous years. The first assistant was reported for carelessness, and was shortly afterwards arrested by the police on some grave charge. His duties were for some time carried on by an assistant sent from the Madras

Office. The observatory was inspected on 10th to 13th August, when Miss Pogson found numerous omissions and alterations in the office records, and it was found that the temporary observer had been extremely careless. Miss Pogson made a number of changes in order to place the observatory on a satisfactory footing. The observer, who had meanwhile been acquitted of the charge for which he was arrested, was allowed to resign and a new observer appointed, who has done his work satisfactorily up to the present time.

Cochin was visited on the 24th and 25th January by Miss Pogson. The instruments were all in good order except the barometer, the mercury in which has become very considerably oxidised. The anemometer and wind vane are in a very unsuitable position as regards exposure, but Miss Pogson was unable to obtain a better site.

Coimbatore was inspected by Miss Pogson on the 29th and 30th of March and found to be in a most satisfactory state. The instruments were all in good order. The anemometer is erected on the southern pole of the thermometer shed at a height of 14 feet above the ground, and is hence in a very unsuitable position for correct observation. The Superintendent has therefore suggested that a brick tower should be erected on which it could be placed.

Cuddapah was inspected on the 17th to 19th August 1886, when everything was found to be in excellent condition. A comparison of the barometer with a portable secondary standard appeared to show that the adopted correction for index error had increased by $\cdot 031$. The erection of the anemometer and wind vane on the site selected had to be postponed, as the roof of the Civil Dispensary was reported to be too weak to support with safety the additional structure. It is now proposed to erect a staging in the compound near the shed.

Kurnool was not inspected during the year, but the observations appear to have been accurately taken, and were sent in with punctuality. The anemometer and wind vane have not as yet been erected in consequence of the difficulty of providing a suitable staging. There is no available building upon which they could be placed and properly exposed.

Madura was inspected on the 22nd of January. The observer has worked more satisfactorily during the past year than hitherto. The shed and compound were found to be neat and clean and free from shrubs and weeds, in which respect a great improvement had been made during the year. The instruments were in good order and the condition of the observatory satisfactory.

The superintendence of the Mangalore Observatory was transferred to the Port Officer during the year. The barometer was removed to the Port Office from the Telegraph Office, where it had hitherto been kept, and the clerk of the Port Officer was appointed observer in succession to the Telegraph Master. The observatory was inspected by the Head Clerk of the Madras Meteorological Office, and found to be in perfect order.

Masulipatam has again been the most unsatisfactory of all the Madras stations, and it was not until the last observer was dismissed that any improvement took place. Ample opportunities of amendment were given to Lutchmeepathy Naidu before his services were dispensed with, but he was utterly heedless of all orders or instructions. A. Streenivasa Row, 2nd Assistant of the Bellary Observatory, was transferred to this observatory for a few months, but he requested to be sent back to his former station, and T. Streenivasa Row, a candidate for employment in the Department, who had been under instruction at the Madras Office for about six weeks, was appointed his successor on probation from

the 1st of January 1887. The previous records were frequently erroneous and incomplete, no less than four considerable breaks having occurred in the readings of the barometer, dry maximum, minimum, and grass radiation thermometers during the year. When the Observer went to take the readings of the instruments on the morning of the 7th of January he found the office room open and the barometer broken, apparently wilfully done, as the hasp had been wrenched off the door. No information was, however, obtained as to who the delinquent was. As there were no good barometers available at the Madras Office, a new one was immediately despatched direct to the observatory from Calcutta. Since the change of observers, the observations have been more reliable. Miss Pogson remarks that if Assistant Surgeon A. Guru Singh had enforced the due observance of all instructions from the Madras Office on the dismissed observer, instead of encouraging him to act in direct opposition, most of the difficulties experienced might have been obviated. Fortunately for the Department, he was superseded in November by a medical officer interested in meteorology, under whose guidance we may look forward to better results in future from the observatory under his care.

The work of the Mercara Observatory was carried out satisfactorily throughout the year. With the exception of the records of the grass minimum thermometer, the register was complete and continuous until the 27th of January 1887, from which date the readings of the barometer were suspended until the 11th of February, by order of the Chief Superintendent of Telegraphs, through some misunderstanding. In accordance with the wishes of the Meteorological Reporter to the Government of India, a separate set of meteorological instruments was supplied to the new observatory situated in the Civil Dispensary compound, and a series of one year's comparative observations commenced from the 1st of January 1887.

The Negapatam Observatory was inspected on the 31st of January, and the barometer and all the thermometers found to be clean and in excellent condition. The thermometer shed and enclosure were in proper order. The records were neatly bound, letters and office papers carefully filed, and the general condition of the observatory highly creditable to the Medical Officer in charge and his assistant.

The Rajahmundry Observatory was not inspected during the year, and as both the sun and grass radiation thermometers were broken, and the anemometer and wind vane have not yet been erected, the register, though continuous regarding the records of other instruments, was very incomplete. The assistant appears to take his observations correctly, and his work has given satisfaction throughout the past year.

The Salem Observatory was not inspected during the year. The observations were taken correctly and harmonised with those of neighbouring stations.

Secunderabad was inspected by the Meteorological Reporter for Western India at the request of Mr. Blanford. The barometer and thermometers were all in capital order. The exposure of the anemometer is not quite satisfactory. Mr. Chambers remarks of the observer: "Mr. Williams appears to do his work in a very orderly, careful manner, and his registers are so exceedingly neat that it is quite a pleasure to look at them."

Trichinopoly was inspected on the 26th, 28th, and 30th of January. The first assistant was absent, failing health having obliged him to take a few days' leave, but the second assistant was present when Miss Pogson visited the observatory at 8.30 A.M. on the 26th, although he was not aware of her arrival. The thermometer shed, side

screens, and enclosure were all in excellent condition. The cage and thermometers were clean and faultless, with the exception of the two solar radiation thermometers, which had portions of the mercurial columns fixed in the upper extremities of the tubes, for which allowance was made by the assistant. The receiving bottle of the rain gauge had been broken a short time previously, and, as the gauge itself required re-japanning, it was replaced by a new one of the same kind. The anemometer staging had been finished and was ready to receive the instruments. The anemometer and wind vane were erected during Miss Pogson's visit and left in working order. With the exception of the surface of the mercury in the cistern of the barometer being slightly oxidised, that instrument was clean and in perfect order.

The Wellington Observatory was inspected on the 31st March, when the thermometer shed, cage, and instruments were found clean and in good order, the only defect being in the solar radiation thermometer which had a small piece of the mercury column detached. The surface of the mercury in the cistern of the barometer was much oxidised. The barometer was removed to a much more suitable room on the same level on the 15th of April. The anemometer was in good working order, and the general condition of the observatory was very creditable.

The remaining observatories have not been inspected during the year, but are considered by Miss Pogson to be working satisfactorily.

A list of the Superintendents and Observers is given in Appendix C.

Special allowances have been granted during the current year to the following observers:—

Names.	Stations.	Amounts.
		<i>R</i>
C. S. Saminatha Pillai . . .	Coimbatore . . .	5
V. A. Vajiravalu Mudeliers . . .	Cuddapah . . .	5

OBSERVATORIES IN BURMA.—Three additional observatories have been opened in Upper Burma during the past year, and hence the number of observatories in Burma is now eleven, including Akyab, which is under the administration of the Meteorological Reporter to the Government of Bengal, and Diamond Island, Mandalay, Bhamo, and Kindat, which are under the Central Office. The remainder are under the Sanitary Commissioner for Burma. Of these, three,—Rangoon, Tounghoo, and Thayetmio,—were inspected by the Sanitary Commissioner. The Rangoon Observatory, the only second class observatory in the Province, continues to work very unsatisfactorily, and the observations when compared with all the neighbouring stations show such large and numerous discrepancies as to indicate frequent gross carelessness on the part of the observer. If the observations do not improve, it will be necessary to make some change. The cost of a second class observatory is about six times that of a third class observatory, and the chief object of this increased expenditure is to obtain more accurate and trustworthy observations. Hence, if the condition of the Rangoon Observatory does not improve very considerably during the present year, I think it should be reduced to a third class observatory, and the money thus saved be spent to some more useful purpose in the department elsewhere. The instruments were reported by the Sanitary Commissioner to have been generally in good order. There were several changes in the observing staff which, to some extent, explains the numerous mistakes that were detected in the returns and observations.

The five 3rd class observatories under the Sanitary Commissioner were all favourably reported upon. They are steadily improving in character and in importance to our meteorological system.

A list of the Superintendents and Observers is given in Appendix C.

Special allowances for the present year have been re-allotted to the following observers:—

Names.	Stations.	Amounts. R
T. H. Hilbert . . .	Moulmein . . .	. 5
Maung Pe . . .	Bassein . . .	. 5
Sheik Hydiet Ally . .	Tounggoo . . .	. 5

OBSERVATORIES AT THE BAY ISLANDS.—An observatory has been established at the lighthouse on the Cocos Islands to the north of the Andamans. The three observatories in the Bay Islands have on the whole worked fairly well, but no special report has been received on their working and condition. The observations taken by Mr. Carroll, the observer of the Port Blair Observatory during the past year, have not been quite so satisfactory as those of previous years. There has again been a succession of observers at Nancowry, and the observations have hence not been so accurate or trustworthy as might be desired. They are enumerated in Appendix C.

EXTRA INDIAN OBSERVATORIES.—There are six of these, as in the preceding year. With the exception of Amini Divi, which is controlled by the Meteorological Reporter to the Government of Madras, the others send their registers direct to the Imperial Office. Aden has improved very greatly, and the observations have been sent in throughout the year with due regularity. The Leh Observatory, since the Actinometric Observer, Sergeant Rowland, and his Assistant quitted Leh, worked very unsatisfactorily for some time; but since the 1st January 1887 it has been placed under the superintendence of the Revd. F. A. Redslob of the Moravian Mission, and has sent in valuable and accurate observations from that date.

The observatories at Bushire and Katmandu have worked fairly well.

The observatory at Quetta has continued to send in accurate observations.

The Amini Divi Observatory, as stated in last year's report, was re-established in May 1886. Hospital Assistant J. D'Cruze took charge of the observatory from the 10th of May 1886 and commenced the register from the 11th, but, as communication between Mangalore and the island ceased soon after his arrival, no returns or information regarding the state of the observatory could be furnished until it was restored, which was not until December. Eleven letters containing a report on the position, structure, and general condition of the observatory, and numerous requests for various improvements, repairs, &c., together with the records and correctly reduced registers from May to September 1886, reached the Madras office on the 6th of December.

No subsequent records and registers were received up to the 31st of March. All the readings of the dry maximum thermometer were so erroneous that they had to be rejected. The new anemometer, No. 629, Casella, which had been in use since the 11th of May 1886, ceased working from the 20th to the 22nd of June through rust, although the observer stated that he kept it well oiled. He took it down, cleaned, and oiled it, after which it worked better. From the 1st of April to the 11th of May 1886, the interval between the departure of the former observer and the arrival of his successor, no

meteorological observations were taken on the island, but from the date on which Mr. D'Cruze took charge, there has been a decided improvement in the working of the observatory. He appears to take an interest in his duties, and in order to prevent any future breaks in the continuity of the observations, he has instructed his Hospital Assistant to record the instruments. Having fulfilled the conditions under which his allowance from the Meteorological Department was to be doubled, he has been permitted to draw the full amount of ₹ 30 per month for the last year. As the thermometer shed had been reported to be in a very dilapidated condition, and it was almost impossible to get good workmanship done by the islanders, a new thermometer shed was constructed at Madras. When boats were able to ply between the Lakhadives and Mangalore, J. Vythinathe Iyer, 1st Assistant of the Madras office, was deputed to proceed to Amini Divi with the shed, and to see it properly erected.

On Vythinathe Iyer's arrival at Amini Divi on the 21st January 1887, he found the thermometer shed unlike either those of the Calcutta or Madras pattern, and of a very inferior and faulty type. The thermometer cage was fixed in a slanting direction, so that the bulbs of the horizontal thermometers were raised above the upper ends of the tubes, which would in a measure account for the past erroneous readings. The instruments in the cage were clean and in good order, with the exception of the dry maximum thermometer which was defective, its readings occasionally being lower than those of the dry bulb. The anemometer was not in good working order, and the brickwork staging on which it was erected was so broken down, that it was dangerous for any one to attempt to mount the ladder to read it. The old instrument was therefore dismantled, and a new one, Casella, No. 240, erected on a cocoanut tree, to which a ladder of the same wood is attached. The cups of the anemometer are about 18 feet from the ground, and there is no other higher object near enough to interfere with its readings. The wind vane had been destroyed some time ago, so it was substituted for the present by one of the small ones by Adie. The raingauge was well situated, but it had no receiving bottle or can, and was replaced by a new one. The height of the raingauge is one foot from the ground. It is placed within a fenced enclosure. The barometer hangs in a room belonging to the dispensary in a good light, and, with the exception of the mercury in the cistern being a little oxidised, it was in perfect order. The posts of the new shed were firmly fixed in concrete, and the whole structure completed by the end of January. The thermometer cage was then removed to its new position, and observations were commenced in the new shed on the 1st of February, on which date the new maximum thermometer, anemometer, and raingauge were taken into use.

A list of the Superintendents and Observers is given in Appendix C.

INSTRUMENTS.

In Appendix D is given a return of the instruments in store at the beginning of the year, and of those received and issued by the Calcutta Meteorological Office, and includes the stock, receipts, and issues of the Alipore Observatory; and in Appendix E is a return of the instruments issued to each observatory. In this are incorporated the returns furnished by the local Reporters.

METEOROLOGICAL OFFICERS AND OFFICE WORKS.

The general administration of the meteorological observatories and offices in the different provinces, with the local exceptions noticed in the foregoing sections, has been in the hands of the following officers during the year :—

Names.	Office.	Province.
H. F. Blanford, Esq., F.R.S. . . .	Meteorological Reporter to the Government of India.	Central Office.
W. L. Dallas, Esq.	Assistant Meteorological Reporter to the Government of India.	
Lala Ruchi Ram Sahni, M.A. . . .	Second Assistant Meteorological Reporter to the Government of India.	
A. Pedler, F.C.S. (Offg.) . . . }	Meteorological Reporter to the Government of Bengal.	Bengal and Assam.
J. Eliot, M.A. }		
S. A. Hill, B.Sc.	Meteorological Reporter to the Government of North-Western Provinces and Oudh.	North-Western Provinces, Oudh, Rajputana and Central India (part).
W. L. Dallas, Esq.	Meteorological Reporter to the Government of Punjab,	Punjab.
Surgeon-Major W. Nolan, B.A., M.D. }	Meteorological Reporter for Western India.	Bombay, Berar, Rajputana, and Central India (part).
Surgeon J. Parker, M.D. . . . }		
F. Chambers, Esq. }		
Miss Isis Pogson	Meteorological Reporter to the Government of Madras.	Madras, Mysore, Coorg, and Hyderabad.
Dr. J. H. Loch	Sanitary Commissioner, Central Provinces.	Central Provinces.
Dr. C. Little	Sanitary Commissioner, Berar . .	Berar.
Dr. D. Sinclair	Do. do. Burma . .	Burma.
Surgeon-Major W. N. Keefer . . .	Senior Medical Officer, Bay Settlements	Andaman and Nicobars.

During my absence on furlough, from the commencement of the year until the 23rd September 1886, Mr. A. Pedler continued to officiate as Meteorological Reporter to the Government of Bengal. Mr. F. Chambers was absent on privilege leave for three months from the 20th August 1886, from which date to the 22nd September, Surgeon-Major W. Nolan held charge of the appointment. During the remainder of the period of Mr. Chambers' leave, Surgeon J. Parker officiated as Meteorological Reporter for Western India. With these exceptions, the local Reporters' duties have all been performed by the permanent incumbents of the several offices.

The 2nd Assistant Lalla Ruchi Ram Sahni, M.A., was appointed to that office on the 1st June 1885, after a probationary course in the department. He was chiefly employed in preparing the daily weather reports and the daily weather charts, and during Mr. Dallas's absence from Simla when inspecting observatories in the cold weather, he was left in independent charge of the Simla Office. He became dissatisfied with his position and prospects in the Meteorological Office, and finally left it on 28th March 1887 to take up an appointment in the Punjab Education Department.

The following table shows the number of stations, the registers of which were sent to

each of the Reporters respectively, for reduction and verification during the year under report :—

PROVINCE.	METEOROLOGICAL REPORTERS.						
	India.	Bengal.	North-West- ern Provinces and Oudh.	Punjab.	Western India.	Madras.	TOTAL.
Bengal and Assam	4	20	...	...	...	...	24
North-Western Provinces and Oudh	2	...	14	...	...	...	16
Punjab	2	...	...	11	...	...	13
Rajputana and Central India	1	...	4	...	4	...	9
Central Provinces	11	...	...	...	...	...	11
Berar	1	...	...	...	4	...	5
Bombay . . . . .	...	...	...	...	13	...	13
Madras, Mysore, and Coorg	1	2	...	...	1	16	20
Burma	10	1	...	...	...	...	11
Bay Islands	3	...	...	...	...	...	3
Extra Indian	5	...	...	...	...	1	6
	40	23	18	11	22	17	131

The list does not include the registers of the provincial observatories in Bengal, nor those of Colaba Observatory, Madras, Goa and of Jeypore, which are furnished to the Meteorological Office with all the necessary reductions.

In Bengal, the North-Western Provinces, Madras, and Bombay (in part), the Reporters superintend the rainfall registers of the district and sub-divisional stations of their respective provinces, and the three former prepare weekly and monthly returns of the rainfall.

The number of rainfall stations dealt with by each of the above officers is as follow:—

	Stations.
Bengal	249
North-Western Provinces and Oudh	260
Madras	317
Bombay	457

In last year's report it was mentioned that the Government of the North-Western Provinces and Oudh had issued orders to the district officers directing them to replace the present antiquated raingauges at the sub-divisional stations by new ones of Symons's pattern as fast as the former ones became unserviceable. Up to the end of December last the old gauges had been withdrawn from use at the following places :—

Thatia Tirwa in Farukhabad district.	Chakia in Mirzapur district.
Kaimganj do. do.	Robertsganj do. do.
Chibramau do. do.	Dudhi do. do.
Narwal in Cawnpore do.	Srinagar in Garhwal do.
Kulpahar in Hamirpur do.	Malihabad in Lucknow do.
Mahoba do. do.	Dalmau in Rae Bareilly do.
Chunar in Mirzapur do.	

The chief stations of the forty-nine districts into which the North Western Provinces are divided having been already supplied with accurate gauges, a few years more should suffice for the complete renewal of the instrumental equipment for rainfall registration. A much longer time will, however, in all probability be required to impress upon the subordinate

officials charged with the execution of this work the necessity of care and attention in the performance of this part of their duties. On comparing the registers of the observatories in the North-Western Provinces and Oudh, with those kept by the revenue officials at the same stations during the year 1886, it will be seen that in the great majority of the cases the observatory records more rain than the tahsil, while in every case, without exception, the tahsil officials neglected to register several light showers. At Roorkee only 30 out of 78 rainy days were noted, and the rainfall recorded at the tahsil amounted to only about 60 per cent. of the total which fell. Even at Allahabad and Gorakhpur, where, owing to partial distribution of many of the showers, it happened that more rain fell at the tahsil or Collector's Office than at the observatory, 20 or 30 per cent. of the total number of separate falls of rain were neglected. The truth of these statements will be evident from the following table:—

Stations.	TOTAL RAINFALL IN 1886.		DAYS ON WHICH RAIN WAS MEASURED.	
	Observatory.	Tahsil.	Observatory.	Tahsil.
	Inch.	Inch.		
Dehra	95'84	91'30	100	91
Roorkee	33'95	24'40	78	30
Meerut	34'35	34'23	49	47
Bareilly	51'94	43'70	69	39
Agra	33'16	30'29	49	37
Allahabad	37'18	43'04	76	51
Benares	49'69	48'11	88	63
Gorakhpur	52'98	55'00	73	60
Ghazipur	55'76	51'03	86	59
Jhansi	36'75	34'42	74	54
Pithoragarh	58'13	51'00	131	80
Ranikhet	55'49	49'23*	103	83*
Lucknow	43'41	42'50	68	56

* At the treasury.

The only important alteration in the work of the Punjab Meteorological Office during the past year has been the acceptance by it of the duty of issuing the rainfall and crop returns, which up to the present have been prepared in the Office of the Director of Settlements. The date on which the transference takes place has not yet been settled, as it depends on the completion of certain modifications in the manner of issuing the report, which are now under the consideration of the Lieutenant-Governor. When these modifications have been agreed to, the publication will be transferred to the Meteorological Department.

In Madras the Revenue Board rain stations were transferred from the Government Astronomer to the care of the Meteorological Reporter to the Government of Madras from the 1st of January 1886. Prior to this change, 100 new raingauges were duly tested and issued by the Government Astronomer, and the original number of 217 rainfall reporting stations was thus increased to 317. Of these, 89 new stations submitted rainfall returns from the 1st of January, seven from April, and two from May, and from the remaining two no returns have as yet been received. All the raingauges issued were made at the Madras Public Works Workshops and were duly tested as to size of funnel and contents of glass measure at the Astronomical Observatory, so that the uncertainty should be within 0·005 per inch of rainfall. Copies of rain reports were forwarded to the Meteorological Reporter, and the monthly results tabulated and published in the usual form in the *Fort St. George Gazette*. None of the rain gauge stations have been inspected hitherto, which is very necessary, as it appears that the gauges are irregularly placed at various heights, some being on the ground, others on brick pillars, and others on the roofs of buildings.

The Reporters for Bengal and Western India administer a system of storm warnings for the protection of the local ports. In the case of the former, this duty has hitherto been restricted to the port of Calcutta, signals being exhibited at certain stations on the Hooghly estuary, more especially for warning vessels about to put to sea. Lately, as has been already noticed in Part I of this report, the system has been extended, so as to comprehend all the principal ports of the Bay of Bengal.

The meteorological observations copied from the log-books of ships entering the port of Calcutta are now received and tabulated in the Central Office, Calcutta.

Mr. Dallas having been relieved of the work of preparing the daily weather report and chart, discharged the duties of the Meteorological Reporter for the Punjab during the year. He has continued the reduction and preparation for publication of the marine observations relating to the North Indian Ocean and the Bay of Bengal, received in 1877 and 1880 from the London Meteorological Office. The barometric, wind, and current charts of the Bay of Bengal, with a descriptive text, have been printed and issued. Considerable progress has also been made with the corresponding series for the Arabian Sea, and the second series which will practically complete the work will be probably published in the course of the present year.

OFFICE ESTABLISHMENTS.—The following is a return of the numbers of ministerial officers and menials in the offices of the several Meteorological Reporters:—

	INDIA.		Bengal.	North-West- ern Provinces.	Punjab.	Western India.	Madras.	TOTAL.
	Calcutta.	Simla.						
Head Clerks . . .	1	...	1	1	1	1	1	6
Computers . . .	3	...	...	...	...	...	...	3
Clerks and copyists . . .	5	...	2	1	3	...	4	15
Tabulators . . .	14 ¹	6	9	4	...	8	...	41
Draughtsmen . . .	2 ²	1	1	...	...	...	...	4
Artisans . . .	...	...	3	...	...	...	...	3
Peons and menials . . .	7	5	5	2	2	2	2	25

¹ Besides these, there are four temporary clerks for reducing the London Meteorological Office marine logs. 1

² Besides these, there is one temporary draughtsman for drawing up the marine charts.

Babu Fanindra Mohun Basu has continued in charge of the Central Office in Calcutta with the same excellent results as in previous years. The Head Computer, Babu Nirduksha Kumar Ghosh, has also worked with great intelligence and zeal.

Mr. Pedler (Bengal) reports that his office has worked exceedingly well under the able superintendence of Babu Chandi Charan Chatterjee, and Mr. Hill (North-Western Provinces and Oudh) reports generally that the clerks and tabulators have all worked steadily and well during the year, under the Head Clerk Babu Chintamony Ghosh. Of the establishment of the Madras Office, Miss Pogson states that her assistants have worked accurately and diligently throughout the year.

WEATHER BULLETINS AND STORM-SIGNAL SERVICE.—Since the 8th April 1885 the daily weather reports issued under the authority of the Department of Revenue and Agriculture have been drawn up at Simla, a permanent establishment being retained there for the purpose. The reports were issued in the same form as in the previous year. The verbal summary, which accompanies each issue, is telegraphed to all the Provincial Governments, and copies are furnished to the daily newspapers at Calcutta, Allahabad, and Bombay.

Two hundred and ninety-five copies of the printed report are issued daily to Government officers and one to a subscriber.

As a part of the work connected with the daily reports, notice is sent by urgent telegram to the Meteorological Office, Bombay, of the progress of any storms that advance from the Bay of Bengal towards the Western Presidency; and notice by urgent telegram is sent to the Civil and Political Officers of Khandesh and Guzerat of the appearance of storms likely to produce floods in the Tapti and Nerbudda; arrangements have been made also for telegraphing direct to the same officers, from certain observatories in the upper drainage basins of these rivers, the occurrence of heavy rain, in order to give them due warning of probable floods.

In Bengal, the Daily Weather Report for the province was issued from the 27th April to the 4th November, and the Bay of Bengal Weather Report (illustrated by a chart) throughout the whole year. The latter was issued to 39 Government officers and 22 subscribers, the former to 98 Government officers and 19 subscribers.

In Bengal it was only necessary to hoist the signals once during the year, namely, on June 15th and 16th. They were hoisted to indicate the existence of a cyclonic storm, which was formed at the head of the Bay of Bengal on the 13th June, and after intensifying considerably, moved in a north-westerly direction, the centre passing near Saugor Island, and then through South-West Bengal, Chutia Nagpur, and South Behar. Night signal No. 10 was hoisted at 2-30 A.M. of the 15th at the signal stations in the river Hooghly, and it was followed by day signal No. 6, denoting that a small cyclonic storm was advancing up the Bay, which would cross the coast north of a line joining False Point and Chittagong. Notices were also given to the Port Commissioners, Calcutta, and the Port Officers at Calcutta, Balasore, Chandballi, and False Point. Notice of the hoisting of the signals was also given in the *Telegraph Shipping Gazette*. At 6-25 P.M. orders were given to hoist day signal No. 9 to be followed by night signal No. 11, danger signal, indicating the approach towards Saugor Roads of a cyclonic vortex of small extent of the kind which forms during the rainy season. The Executive Engineers at Balasore and Midnapore were also informed. At 7 o'clock of the morning of the 16th, the centre of the storm reached the coast very close to Saugor Island, and slightly to the east of it, and

as it was still advancing in a northerly direction, the only available warning signal No. 12 for the Port of Calcutta was hoisted, signifying the existence of a cyclone, the centre of which was near Saugor, and that the storm was probably advancing towards Calcutta. This signal was the only one that could possibly be used to apprise the Calcutta Port of the storm in question. It is, however, intended for use only in the approach of storms of great magnitude and intensity, and though Mr. Pedler was aware that the storm was not one of the very intense and fierce cyclones which are generated perhaps once in ten years, yet he was certain that the storm was of sufficient intensity to make it very dangerous for shipping to move in the river and in the port, and hence this signal was hoisted. At midday of the 16th, the centre of cyclonic storm was between Saugor and Calcutta, and was advancing in a north-westerly direction. Information was received at 2-55 P.M. that the flagstaff at Mud Point was broken by the wind force and the storm signals could not be again hoisted at this station. On the 17th the storm centre proceeded inland through Midnapore and the adjacent districts, and the storm-signals which were hoisted at the port and at the river stations were therefore ordered to be lowered at 4 A.M. of that day, and the Port Officers at Balasore and Chandbali were informed accordingly.

A considerable number of smaller and feeble cyclonic storms and barometric depressions occurred during the prevalence of the south-west monsoon over the Bay. A rather severe but small cyclone was also formed during the first advance of monsoon winds up the Bay, which broke on the Madras coast, and also a remarkable series of three fierce cyclonic storms was formed in the Bay in November and December, all of which crossed the Madras coast, following approximately similar courses. The principal depressions formed in the year are described in Mr. Pedler's report as follows:—

1. *Storm of May 23rd and 24th.*—This was formed off the south Madras coast, and at some little distance to the east or south-east of Madras on May 22nd and 23rd. By 10 A.M. of the 24th the storm was advancing over the coast line between Negapatam and Madras, and the centre of the storm, which probably passed not very far from Pondicherry, was almost on the coast at this time. It was a storm of considerable diameter, and was very fierce near the centre. The S.S. *Tibre* was involved in the storm. At 2 P.M. of the 23rd the Meteorological Reporter, Madras, and the Port Officers at Negapatam, Masulipatam, Coconada, and Vizagapatam were telegraphed to the following effect:—"Cyclonic storm south-east of Madras and apparently approaching coast." At 1-10 P.M. on the 24th, it being found that the cyclone was crossing the Peninsula, the following telegram was despatched to the Meteorological Reporter, Bombay:—"Cyclonic storm of considerable intensity crossing Peninsula south of Madras." By the morning of the 25th the storm had entirely passed inland, and it afterwards apparently passed into the Indian Ocean. It gave heavy rainfall on its onward march to Negapatam and adjacent places.

2. *Feeble depression of 1st June.*—At the close of May there formed off the Pegu coast a storm which reached the South Bengal coast on June 1st, the centre passing between Saugor Island and Chittagong. The centre on the 2nd was not very far from Burrisal, and it then advanced inland and filled up, giving very heavy rain to South-East Bengal.

3. *Depression of 6th and 7th June.*—This depression was also very feeble. It formed off the Pegu coast about the 6th of June, and on the 7th advanced inland near Akyab

and between that station and Chittagong. It also brought up heavy rain to South-East Bengal.

4. *Depression of 9th to 19th July.*—During the whole of the eleven days of the existence of this depression, which was formed at the head of the Bay, winds were more or less cyclonic in direction, though light in force. The storm possessed little strength till about the 16th, when it had slightly intensified. On this day the centre, as far as could be judged, was to the east of False Point and almost to the south of Saugor Island. On the 17th the small storm again intensified, and was a little to the north of False Point. It then passed inland, bringing heavy rain in its advance. On the 18th the centre was considerably to the north of Cuttack, and moving in a north-westerly direction. It filled up and disappeared on the 20th.

5. *The depression of 16th to 20th August.*—This was formed off the Ganjam coast on the 16th. It was a feeble storm as judged by the barometric depression, but gave a heavy sea and very bad weather over that part of the Bay. It passed inland, to the north of Gopalpore on the 19th.

6. *The feeble depression of 13th to 17th September.*—It was formed in the north-west angle of the Bay on the 13th, and crossed the Orissa coast on the evening of the 15th, and passed into Chutia Nagpur on the 16th, when it broke up.

7. *The feeble depression of 18th to 24th September.*—This was formed in the north-west angle of the Bay. The centre passed inland between False Point and Balasore on the evening of the 21st. It gave heavy rain to Orissa and South-West Bengal and South and Central Behar.

8. *Depression of 24th to 30th September.*—This was formed off the Arakan and Pegu coasts on the 24th, but did not begin to influence the Bengal coast until the 27th, when it was approaching the Ganjam coast. It gave heavy rain to Orissa and South-West Bengal, and moderate rain to Behar and Chutia-Nagpur.

9. *Depression of 18th and 19th October.*—This was formed in the centre of the Bay and moved towards the Ganjam coast, which it crossed early in the morning of the 20th and drifted westwards into the interior. The Port Officers at Gopalpore and Vizagapatam were apprized of the existence of the storm on the 18th. It gave heavy rain to the west coast of the Bay.

10. *Storm of 6th to 13th or 14th November.*—A definite cyclonic vortex showed itself on the 5th or 6th in the centre and south of the Bay. It marched to the west-north-west, and struck the Madras coast, the centre crossing the coast a little to the north of Madras shortly before noon on the 9th. It advanced across the Peninsula unbroken, and then passed into the Arabian Sea, marching to the north-west. The Peninsular and Oriental Company's steamer *Peshawar* was involved in it on the 13th. At 3-15 P.M. on the 7th the Master Attendant, Madras, and the Port Officers, Gopalpore and Coconada, were apprized of the formation of the cyclonic storm, and at 2-45 P.M. of the 8th, telegrams announcing the storm were sent to the Master Attendant, Madras, the Port Officers at Gopalpore and Coconada, to Weather Bombay, and to A. V. Nursing Row, Esq., Vizagapatam, to the following effect:—"The cyclonic storm I warned you about yesterday appears to be of large extent and of considerable intensity. The centre is advancing westward, and will probably strike the coast north of Madras and between Madras and Masulipatam within the next 24 hours."

11. *Storm of 18th to 24th November.*—This was formed in the Martaban Gulf, and it passed into the Bay of Bengal to the north of Andamans. The centre of the disturbance was in about 16° north latitude, and 89° east longitude at noon of the 22nd, and $16\frac{1}{2}^{\circ}$ north latitude and $84\frac{1}{4}^{\circ}$ east longitude at noon of the 23rd. It struck the coast between Vizagapatam and Coconada late on the evening of that day, and broke up a few hours afterwards. At 2-50 P.M. of the 22nd, the following telegram was despatched to the Port Officers at Gopalpore, Vizagapatam, Coconada, Masulipatam, and Master Attendant, Madras, and also to Mr. A. V. Nursing Row:—"A cyclonic storm, accompanied by very strong winds, has formed near the Andamans, and is moving apparently towards the mid-west coast of Bay. It is probably not of large extent; advisable to watch weather." On the 23rd, at 2-35 P.M., the following telegram was addressed to the same officers:—"Present cyclonic storm is approaching the coast of the Circars between Gopalpore and Coconada, and the centre will probably cross the coast near Vizagapatam within the next 24 hours. Storm is apparently of small extent and diffused in character, but accompanied with strong winds." On the 24th, at 2-30 P.M., the following message was sent to the Meteorological Reporter, Bombay:—"Cyclone travelling westward; crossed the coast of the Circars late yesterday evening. The storm appears to be small and diffused in character."

12. *Storm of 7th to 9th December.*—A small storm or cyclone was formed in the south of the Bay on the 7th. It advanced a little to the north of west and struck the Madras coast on the afternoon of the 9th, and shortly after disappeared. It gave very strong winds and a high sea. The Port Officers, Coconada, Masulipatam, Negapatam, and Madras, and Meteorological Reporter, Bombay, were apprized of the existence of the storm.

The following table shows the dates on which warnings were issued to the Bombay coast ports and the nature of the warnings:—

Names of ports.	Dates on which telegraphic orders to hoist the storm-signals were issued.	Dates on which cautionary telegrams were issued.
Kurrachee . .	.....	23rd and 24th July.
Bhavnagar . .	27th May . .	17th June, 23rd and 24th July.
Daman . .	Do. . .	17th June, 23rd and 24th July.
Bombay . .	Do. . .	24th and 25th May, 9th December.
Alibag . .	Do. . .	24th, 25th and 26th May, 17th June, 9th and 12th December.
Ratnagiri . .	25th May . .	24th May, 15th June, 10th November, 9th and 12th December.
Vengurla . .	Do. . .	24th May, 15th June, 10th November, 9th and 12th December.
Goa . .	Do. . .	24th May, 15th June, 9th and 10th November, 9th and 12th December.
Karwar . .	Do. . .	24th May, 15th June, 9th and 10th November, 9th and 12th December.
Kumta . .	Do. . .	24th May, 15th June, 9th and 10th November, 9th and 12th December.

On the 23rd of May 1886, the regular daily telegraphic reports indicated that a barometric depression was forming in the south of the peninsula. Special reports were at once called for from inland stations, and the gradual development of the disturbance on the 24th and 25th was carefully watched. On the 24th the depression had intensified considerably. On the 25th it was a little deeper, and its centre had moved northward to about midway between Karwar and Mangalore. Storm warnings were then issued to the ports to the southward of Bombay. On the 26th the indications seemed to imply that the depression had either moved out to sea, or had broken up, no well marked centre of low pressure being then traceable. The special telegraphic reports were thereupon discontinued. On the 27th, however, a southerly gale sprang up at Bombay, and the storm signals were at once hoisted at Bombay, Daman, and Bhavnagar. The regular daily telegraphic reports of the 27th showed no indications of a barometric depression, and it was not till late in the evening when some of the special reports called for on the same day had arrived, that it became known that a depression had formed in Guzerat.

On the 3rd and 4th October another storm occurred at Bombay. The wind movement during the 24 hours, from 10 A.M. on the 3rd to 10 A.M. on the 4th, was 895 miles, and the maximum velocity in one hour was 45 miles. The regular daily telegraphic reports gave little indication of this storm, and it was not till the Meteorological observations made at inland stations had been received that it became known that a small but definite barometric depression had slowly passed across the Peninsula from Masulipatam to Bombay between the 30th September and 3rd October. It was the rapid development of this depression on reaching the sea near Bombay that gave rise to the gale.

WEEKLY, MONTHLY AND SEMI-ANNUAL REPORTS.—From May to October a descriptive summary of the weather is prepared monthly; during the rest of the year every alternate month; and published in the *Gazette of India*. Reports on the winter and spring snowfall were also drawn up in May and June, and a forecast of the character of the rains was attempted, which has been noticed at length in Part I of this report. Weekly reports have also been published in the *Gazette of India* since the 1st of February. These give a short *résumé* of the weather of the week drawn up partly from the daily reports for the period, and partly from additional rainfall information obtained by telegram from a large number of stations.

Charts of the rainfall for the three seasons into which the year has been divided for this purpose (the cold season, the hot season, and the rains) have been prepared for 1886 from the rainfall registers received by post, and several copies furnished to Government, but these are not published. A general chart and tabular return of the rainfall of the year was also prepared for the Secretary of State.

In Bengal, weekly and monthly Meteorological and Rainfall Reports, for the province are published in the *Calcutta Gazette*, and sets of 3 rainfall charts, showing the actual distribution of the rainfall and its variation from the average, 1st, in absolute measurement and 2nd as a percentage of the normal average, are prepared monthly for Government. A general summary of the weather of the monsoon and the distribution of the rains in Bengal, was also drawn up for the Government of Bengal.

In the North-Western Provinces and Bombay, monthly abstracts of the registers of the several observatories and, in the North-Western Provinces, weekly rainfall reports are

published in the local *Gazettes*, and in the Punjab, since the beginning of 1886, a descriptive summary of the weather of the province has been prepared monthly for Government and published in like manner.

ANNUAL REPORTS.—The report on the meteorology of the year 1885 was complete and in the printer's hands by the beginning of December 1886, and the printed Report submitted to Government on the 21st May 1887.

The report gives tables of temperature for 133 stations, and rainfall returns for 486 stations, being a decrease of five of the former and an increase of eight of the latter on the numbers respectively given in the report for 1884. The returns of most other meteorological elements are nearly as numerous as those of temperature. The elements tabulated in the Appendix are given in the following table. For comparison the corresponding numbers for the four previous years are given:—

	NUMBER OF STATIONS.				
	1881.	1882.	1883.	1884.	1885.
Equilibrium temperatures of solar radiation	106	112	111	113	104
Duration of bright sunshine . . . . .	...	...	2	3	4
Temperatures of nocturnal radiation	106	104	107	106	108
Temperatures of the ground	4	4	4	4	5
Mean and extreme air temperatures	131	130	134	138	133
Sea-level equivalents of mean temperatures	108	108	111	112	111
Means and extremes of atmospheric pressure	251	124	125	127	128
Sea-level equivalents of mean atmospheric pressure	107	108	109	110	110
Direction and movement of winds	127	125	127	128	128
Temperature of evaporation	121	120	124	128	131
Tension of atmospheric vapour	128	127	130	135	130
Mean relative humidity	128	127	130	135	130
Mean proportion of clouded sky	125	124	127	130	131
Inches of rainfall in each month	417	457	462	478	486
Number of days on which rainfall was measured	403	457	462	474	482

The descriptive letter-press discusses the chief characteristics of the meteorology of the year. It includes tables of the average values of all the more important meteorological elements for all stations that have furnished returns for three years and upwards, and the report is illustrated with four plates, *viz.*, a chart showing the position of all observatories and rain-gauge stations, and three in coloured lithography, representing the mean distribution of temperature, pressure, and winds in each month of the year.

The original observations of six observatories, *viz.*, Calcutta, Lucknow, Lahore, Nagpur, Bombay, and Madras, were issued in a distinct publication in monthly parts. Those forming the volume for 1886 were completed in April 1887. Since January 1887, the observations taken at Allahabad have been included in this publication.

The Reporters for Bengal, the North-Western Provinces, the Punjab, and Bombay, each prepared and submitted to the local Governments summaries of the weather features of the year 1885 in their respective provinces.

MISCELLANEOUS PUBLICATIONS.—Part I of Volume IV of the Indian Meteorological Memoirs was issued in May 1886. It contained three memoirs, *viz.*, one on the Akyab cyclone of the 12th to 17th May 1884, one by Mr. Blanford on the diurnal variations of the rainfall of Calcutta, and a third by Mr. Dallas on the meteorology of a sea tract to the south of the Bay of Bengal. A volume of the weather charts of the Bay of Bengal, prepared by Mr. Dallas, was issued in January 1887. It contained monthly charts showing the mean pressure, winds, and currents of the Bay of Bengal and the adjacent sea north of the equator, each chart being accompanied with a page of description.

A set of four charts (one for each quarter), illustrating the specific gravity, temperature and currents of the sea surface of the Bay of Bengal, and the adjacent equatorial sea prepared by Mr. Dallas, and the second part of Volume IV of the Memoirs containing a very full and complete account of the remarkable False Point cyclone of September 16th to the 24th, 1885, drawn up by Mr. Pedler, Officiating Meteorological Reporter to the Government of Bengal, and the third part containing a discussion by Mr. Hill of the ground temperature observations made at the old observatory, Allahabad, and were printed and nearly ready for issue at the close of the year. Mr. Blanford's second paper on the rainfall of India (the continuation of the previous paper on the same subject) is well advanced and will shortly appear. It will complete the third volume of the Memoirs.

Other Memoirs are in course of preparation by Mr. Hill, Mr. Dallas, and myself. Mr. Chambers, on the plea of want of sufficient office assistance, has contributed nothing to the official publications of the department since the list of storms drawn up in 1882, and published in Part I, Volume II of the Memoirs. The two clerks who were assigned to him for special investigation were employed during a portion of the year in making measurements from the anemograms recorded by the self-registering anemographs at Belgaum and Deesa—a work which was also being done in the Central Office in Calcutta.

A paper by Mr. Blanford on the "Influence of Indian Forests on the Rainfall" was published in No. 1, Part II of the Journal of the Asiatic Society of Bengal for 1887; and one by Mr. S. A. Hill on "Solar thermometer observations at Allahabad" in No. 4, Part II of that Society's Journal for 1886. A paper by Mr. Hill on "Some anomalies in the winds of Northern India and their relations to the distribution of barometric pressure" was communicated to the Royal Society, and an abstract of it was published in the Proceedings of the Society for January 1887. Mr. Hill also published in the Journal of the Royal Meteorological Society of London for January 1887 a "Criticism of certain points of Professor Langley's Researches on Solar heat."

Appendix F gives a list of the Government officials, libraries, observatories, socie-

ties, &c., to which the publications of the office are presented, including those which send their own publications in exchange.

LIBRARY.

The additions to the library during the past year are enumerated in Appendix G. The library remains, as last year, in ten double book-cases in a large room on the ground floor of the office building. It is in good order, but it has not been practicable to undertake its re-arrangement, no officer having been available for the purpose.

CALCUTTA :

The 25th July 1887.

JOHN ELIOT,

Offg. Meteorological Reporter to the Government of India.

APPENDIX A.

Extract from the Administration Report of the Meteorological Reporter to the Government of Bengal for the year 1886-87.

* * * * *

Berhampore was visited by my head clerk on 11th August. He reported that the observatory was in an excellent condition. Baboo Mohendra Nath Roy continues to be the observer. His readings are always accurate, and the special allowance of ₹10 which he holds is well deserved. A solar radiation thermometer was stolen from the observatory grounds, while under exposure, on the 2nd January 1887, but the thief could not be discovered. A new instrument was brought into use from 3rd January 1887.

Burdwan was visited by myself on the 7th April 1886. The condition of the observatory was satisfactory. The personal allowance of ₹10 was therefore continued to the observer, Baboo Mokhada Prosad Chowdhry.

Dacca was twice inspected, first by Mr. Dallas on the 26th of July 1886, and then by Mr. Eliot on the 15th March 1887. Mr. Dallas condemned the big dial wind-vane, which was on the centre of the roof, and ordered the removal of the raingauge to a different site, as it was liable to be inundated by the overflowing of the Boreegunga river; and this was actually the case on the 28th August 1886. A Roorkee pattern small-sized vane was supplied. Mr. Eliot selected the position of the new instrument. Mr. Eliot found everything in good order, except the grass thermometer, in which a small portion of the column (about 1°) was detached. It was put right.

Darjeeling was inspected by Mr. Eliot on the 10th and 11th March 1887. He reported—"The instruments and shed were all in good order. The anemograph is working fairly; the instrument is, however, by no means a satisfactory one, and requires constant care to keep it in working order. The bed plate of the upper part of the instrument appears to be very considerably warped, and hence it is necessary to insert wedges in order that the wheels may work into each other. The traces were very good and distinct. The tracing spiral of one of the cylinders had become slightly bent, and the sharp end, which was thus turned over, was tearing the paper. This defect will be rectified as speedily as possible by the observer. The observer is a very sharp and intelligent young man, and takes the observations exactly, and shows much interest in the anemograph." After Mr. Moore, the former observer, had left the station, the observer's allowance was reduced to ₹15 with effect from May 1886, to equalize the pay with that of all third class observers. In consideration of the fact that the observer has to look after the anemograph, which is situated at a distance from the observatory, and which requires constant care and attention to keep it in order, the allowance has again been raised to ₹25 a month, with effect from the 1st January 1887.

Durbhanga was visited by Mr. Eliot on the 25th December 1886. The instruments and shed were generally in good order. The anemometer was condemned and a new instrument supplied.

Gya was visited by Mr. Eliot on 22nd December 1886. The officiating observer, Mukund Lal, was examined and found to be competent. He was trained at the Patna Observatory before being appointed. The observatory was in fair order. Prior to this visit, in November 1886, the officiating observer was fined the full value of a wet minimum thermometer, which had been broken by gross neglect and carelessness. The dry minimum thermometer had a deposit of about ten degrees of spirit in the upper part, which explained the cause of the very low readings of the instrument from 1st August to October 1886, when the instrument was recalled and put into order, and then again brought into use from 26th December 1886. Thus, there was a long break due to the rejection of erroneous readings recorded by the observer.

Patna was visited by my head clerk on the 3rd August 1886, and subsequently by Mr. Eliot on the 21st of December 1886. Surjun Sing was officiating as observer in place of Munshi Mohabhtlal, who was under suspension from August 1886. The observatory was not in good order when examined by the head clerk, nor was the observer found to be very competent. Mr. Eliot found that the observer and the condition of the observatory had improved materially in December 1886. The instruments were quite clean and all in proper order. The shed was newly repaired, and the observer read the instruments correctly.

The Patna observatory is now working well. At present the work of reduction and tabulation of the observations from Patna is being carried on in the Calcutta office, and the allowance for the observer has been reduced to ₹20. The observer has to take the synoptic observations in addition to the regular work of the observatory.

Purneah was visited by Mr. Dallas on the 25th and 26th August 1886. Generally speaking, the observatory was in good condition, so far as the observer and the instruments were concerned. Mr. Dallas reported that the anemometer was very much sheltered to the east and north by high trees, and proposed that both anemometer and wind-vane should be removed to the south-west corner of the jail building. This change of position of the instruments has been made from the 20th January 1887. The wind registration previous to this must therefore be of doubtful value.

Sibsagar was visited by Mr. Dallas on the 17th August 1886. He found the observatory in good working order. He compared the barometer with a standard taken from Calcutta, and found the previously determined correction had remained unaltered. He condemned the position of the meteorological shed. He writes—"The thermometer shed is situated in a hollow, 3 or 4 feet below the level of the ground on which the station is built. In consequence, there is far from a free circulation of air, and as the slope is from south to north, the shed has an undue northern exposure, and the temperature is distinctly lower than over the open ground around the tank. The shed is surrounded by high jungle, and the readings of the thermometers can hardly be taken as representative of the temperature of the surrounding country." The seismometer was reported to be not working at all, as it had failed to give indications of earthquakes, although the shocks were sufficient to crack buildings, so as to render them unsafe.

Baboo Dandadhar Dutt Barua continues to be the observer. He receives a 10 rupee special allowance.

Silchar was visited by Mr. Dallas on the 2nd August 1886. The condition of the observatory was reported to be good. The observer was also found to be a competent man. The instruments were all found to be in working order. A sharp shock of earthquake occurred at 11-25 A.M. on May 19th, 1886, occasioning considerable damage to several bungalows in the station, but the seismograph failed to give any indication. The observer was tested in the methods of reading and recording the indications of the instrument.

Tespore was visited on the 14th August 1886. This is the first visit of inspection since the observatory was started (April 1885). Mr. Dallas reports—"The thermometer shed is situated on the summit of a hill 200 or 300 feet above the level of the river, and is the highest point around. The position is exceedingly good. The river runs on the southern side, and a level wooded plain surrounds the west, north, and east sides of the hill. The anemometer was clean and moving freely. The wind-vane was apparently true, and also running easily, but there was no means of getting up to it." Some arrangement must be made to enable the observer to oil the instrument from time to time.

The barometer is placed in a room in the jail. The sun thermometer and grass thermometer were stolen in June 1886, while under exposure. Dr. Campbell, the Superintendent of the Observatory, suggested that a chowkidar should be appointed to watch the instruments, but Mr. Blanford, the Meteorological Reporter to the Government of India, decided that radiation thermometers should not in future be used at this observatory.

Many readings from this observatory have had to be rejected as erroneous, and the observer was careless and did not understand his work. These errors have been repeatedly pointed out, and the present observations are now fairly good.

The rest of the observatories could not be visited, *viz.*, Akyab, Chittagong, Coconada, Cuttack, Demagiri, False Point, Gopalpore, Hazaribagh, Jessore, and Tura. Their condition can only be judged from the registers furnished, which appear to show that the observers have generally maintained their character for accuracy of observation.

At *Akyab* the shed has been thoroughly repaired during the year.

The observer at *Chittagong* deserves mention, not only for the care and attention he has bestowed on the anemograph, but also for the correctness of his observations.

From *Coconada* the reports were regular and generally satisfactory.

The *Cuttack* observatory, under the Telegraph Master, Mr. Stone, was in a very inefficient state, and either through his carelessness or want of knowledge, many instrument readings have had to be rejected during the course of the year. The anemograph was also allowed to get out of order from want of attention. Mr. Stone has now been transferred from Cuttack.

Demagiri.—This is a voluntary station, having only the ordinary thermometers and a wind-vane as instruments under observation. It cannot be considered a satisfactory station.

False Point.—This observatory has worked well during the year under Mr. Loudon.

Gopalpore has sent in registers and telegrams regularly throughout the year, and the observations have been very satisfactory. The Port Officer appears to take a very lively interest in the work of the observatory.

Hazaribagh.—This is one of the best kept observatories in Bengal. Observer Nathoo Lal has submitted very satisfactory readings throughout the year. The anemograph was kept in working order throughout. The special allowance of Rs 5 drawn by the observer is therefore well deserved.

Jessore.—The condition of the observatory has improved materially, and the observations have been correct. The observer's personal allowance, which was withheld for six months last year for neglect of duty, was restored from 1st October 1886.

Tura.—This is a voluntary station, recording thermometric and wind observations only. It has improved very materially in the character of its observations and in the reports submitted.

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METEOROLOGICAL OFFICE, BENGAL;

ALEX. PEDLER, F.C.S.,

Calcutta, the 16th June 1887.

Offg. Meteorological Reporter to the

Government of Bengal.

APPENDIX B.

Extract from the Administration Report of the Meteorological Reporter to the Government of the North-Western Provinces and Oudh for the year 1886-87.

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Allahabad.—Of the two meteorographs of Van Rysselberghe's construction now in this country the one supplied to Jeypur and marked No. 2 has been the best made and the least knocked about before setting up, though even with this instrument many difficulties had to be overcome before it could be got to work correctly. At the time of writing last year's report I hoped that most of the difficulties experienced with the Allahabad instrument, No. 1, had been overcome; but further experience proved that this hope was illusory, for the instrument is so delicate in its construction, and before coming here had undergone so much wear and tear, that it never could be got to work tolerably well for more than a week at a time. As further experience was gained of its many ways of getting out of order, several defects in construction became manifest, the most important of which were defective insulation of the wires and permanent magnetism of the cores of some of the electromagnets. Experience having also shown that there would be much difficulty and uncertainty in getting these defects remedied locally by the Telegraph Department, it was at last decided to send certain parts of the instrument back to the maker for examination and repair; and at the end of the year under report the instrument was accordingly taken down and the defective parts despatched to the maker, T. Schubart, in Ghent. The staff of three observers, entertained on the establishment of the first-class observatory, will, until such time as the meteorograph is returned, be employed in carrying on the regular observations, and, in addition to these, on two days in every week, in taking hourly observations of wind and cloud and of the temperature and humidity of the air at two heights above the ground differing by 40 feet, as well as under the standard thatched shed at a height of 4 feet. Some investigations into the origin of the hot winds, on which I have recently been engaged, having shown the necessity of further knowledge of the vertical distribution of temperature, I have proposed to utilise the temporary saving of the observatory allotment for paying an electrician, mechanical artificer, and printer, in getting further observations of air temperature and humidity made at different heights on the Muir College tower, which rises to nearly 200 feet. The sanction of Government to this proposal has not yet, however, been obtained.¹

At Allahabad the ordinary eye-observations were made four times daily. Observations or records of the special instruments mentioned in last year's report were also kept up continuously throughout the year. The sunshine recorder continued to act perfectly, but the indications of Frankland's differential solar thermometer were found to be quite untrustworthy, and its observations have now been discontinued. As in former years, the percentage of bright sunshine was considerably higher than that of clear sky given by eye-observations at 10 A.M. and 4 P.M.

The results of observations of temperature and humidity at different heights above the ground are given in the following Tables. These results, as far as they go, bear out the conclusions deduced from similar observations made at Alipore, *viz.*, that in the middle of the day in the hot season the decrease of temperature upwards is very rapid, whereas at night and in the cold weather there is a very considerable increase of temperature on ascending through 40 feet; also, that the decrease of humidity, both relative and absolute, is so very rapid that it is probably in part unreal, being due to the application of the same psychrometer formula to observations made under very unlike conditions as regards the velocity of the wind. Until a series of hourly observations of these

¹ Sanction was obtained while this report was in the press, and the observations were commenced on the 1st May.

thermometers, extending over a year, has been made, the true mean temperatures at the two elevations cannot be given, but from the crude means of maxima and minima it appears that, on the average of the year, the temperature at the upper cage is slightly higher than at the lower one, as was also found to be the case at Alipore.

Ground temperature observations at the surface, and at depths of 1, 3 and 9 feet, were made regularly throughout the year, at 6, 14 and 22 hours, local time; and hourly observations for the purpose of reducing these to daily means were continued down to the end of the calendar year 1886. As these observations are now published in the annual reports on the meteorology of India, they are not given here. From the two years' observations of the earth thermometers completed last December, it appeared that the mean temperature shown by the 1-foot instrument was considerably lower than that at the surface or at a depth of 3 feet, and, as this was probably the effect of convection currents in the air of the tube, the thermometer has since January been wrapped round near the bulb with a plug of hemp tightly fitting the tube. It remains to be seen whether this will have the effect of stopping the convection currents.

By means of the nephoscope, observations of the movements of the upper clouds were made on occasions when such clouds were visible.

The two years' series of comparative observations at the old and new observatory sites were completed at the end of August. The results are given in the enclosed Tables. As regards temperature and humidity the complete series of observations fully bear out the remarks made in last year's report. The air at the new observatory is about half a degree hotter than at the old, on the average but in November it is 1.3° hotter, while in May and June it is slightly cooler. Owing to the more, open and exposed character of the site and its surroundings the temperature of nocturnal radiation is two or three degrees lower at the new site than at the old all through the dry season, and the difference for the whole year averages 1.7° . The solar thermometer also in most months of the year reads very considerably lower at the new observatory than at the old, doubtless because there is less reflexion of heat upon the thermometer from surrounding objects, a cause of variation in its indications to which the black-bulb thermometer *in vacuo* is extremely sensitive. The temperature of the ground at the new observatory appears to be about 2° lower than at the old—a circumstance which seems difficult to reconcile with the contrary difference in the air temperatures, but which is doubtless dependent on the effects of radiation just mentioned, while the relatively low mean temperature of the air at the old observatory is due to its lying in a hollow in which cold air collects at night, and to the shade of the tall trees on both sides of it, which lowers the temperature for some hours after sunrise and before sunset.

* * * *

Jeypur.—The Maharaja's observatory at Jeypur, under the active and intelligent superintendence of Surgeon-Major Hendley, has continued to do excellent work throughout the year, and is in many respects a model worthy of imitation by the Government observatories round it. At the end of December I visited it and found all the instruments in good condition, including the Osler anemograph and the Van Rysselberghe meteorograph, which, in the hands of Mr. Callaghan, the electrician, has now given good, and nearly continuous, traces for four or five years. In addition to all the ordinary elements of observation and record, registers are kept at this station of the duration of sunshine, the movements of the upper clouds, and the temperature of the ground. Observations of the last, at various depths down to 20 feet, have now been made for six years, and in December arrangements were being made for taking the temperature at a depth of 50 feet. As this is below the spring water-level, the tube which was to contain the 50-foot thermometer was closed at the bottom to prevent the ingress of water, which would tend to equalize the temperature by convection currents; but, as this tube is made of iron, the temperatures indicated at its lower end will doubtless be affected to some extent by the high conducting power of that material. From Dr. Hendley's annual report it appears that numerous fourth-class observatories, recording temperature, rainfall, and wind direction only, have been established during the year at dispensary stations in the Jeypur territory; so that

that territory on the border of the Indian desert has now, including the Government observatory at Sambhar Salt Lake, a more complete meteorological establishment than any other equal area in India. Dr. Hendley speaks very favourably of the work of the observers, and in his opinion of it I heartily concur.

ALLAHABAD,

The 14th April 1887.

S. A. HILL,

Meteorological Reporter to Govt., N.-W. P. and Oudh.

Comparison of Air temperatures at heights of 6 and 46 feet above the ground at the Allahabad Observatory.

MONTH.	5½ H.			13½ H.			21½ H.			MAXIMA.			MINIMA.			RANGE.		
	Lower cage (6 ft.)	Upper cage (46 ft.)	Differ-ence.	Lower cage (6 ft.)	Upper cage (46 ft.)	Differ-ence.	Lower cage (6 ft.)	Upper cage (46 ft.)	Differ-ence.	Lower cage (6 ft.)	Upper cage (46 ft.)	Differ-ence.	Lower cage (6 ft.)	Upper cage (46 ft.)	Differ-ence.			
April 1886	73.5	76.3	-2.8	99.7	98.2	+1.6	83.8	87.4	-3.6	101.7	99.7	+2.0	72.1	74.3	-2.3	29.3	25.3	+4.0
May "	80.2	80.9	-0.7	100.3	98.8	+1.5	88.9	90.0	-1.1	103.3	100.9	+2.3	79.0	80.0	-0.8	24.3	21.1	+3.2
June "	83.6	83.9	-0.3	98.2	96.7	+1.5	88.8	89.8	-1.0	100.3	98.2	+2.1	82.3	82.2	+0.2	18.3	16.7	+1.6
July "	80.5	80.4	+0.1	87.4	86.3	+1.1	82.2	82.4	0.2	89.8	88.4	+1.4	78.7	78.6	+0.1	11.1	9.8	+1.3
August "	79.7	79.7	0	88.1	87.2	+0.9	82.0	82.2	-0.2	89.7	88.4	+1.3	78.8	78.8	0	10.9	9.6	+1.3
September "	78.2	78.3	-0.1	88.5	88.1	+0.4	80.7	81.7	-1.0	90.2	89.2	+1.0	77.2	77.3	-0.1	12.9	11.9	+1.0
October "	74.2	75.3	-1.1	85.5	85.9	-0.4	76.7	78.9	-2.2	86.7	86.8	-0.1	73.4	74.1	-0.7	13.3	12.7	+0.6
November "	60.3	63.5	-3.2	79.5	80.9	-1.4	66.4	71.2	-4.8	80.7	81.6	-0.9	59.3	61.8	-2.5	21.3	19.7	+1.6
December "	53.3	55.7	-2.3	70.8	71.7	-0.9	59.1	63.0	-4.1	72.0	72.5	-0.5	52.4	53.6	-1.2	19.0	18.9	+0.1
January 1887	51.8	53.5	-1.7	67.6	68.1	-0.5	57.0	59.8	-2.8	68.9	68.9	0	50.7	51.3	-0.5	18.2	17.6	+0.6
February "	52.0	55.5	-3.5	75.1	76.0	-0.9	61.5	66.4	-4.9	76.9	77.6	-0.7	50.8	53.2	-2.4	26.1	24.4	+1.7
March "	63.9	67.2	-3.3	88.5	88.9	-0.4	73.6	78.4	-4.8	90.3	90.5	-0.2	62.3	64.8	-2.5	28.0	25.7	+2.3
Year	69.3	70.9	-1.6	85.8	85.6	+0.2	75.0	77.6	-2.6	87.5	86.9	+0.6	68.1	69.2	-1.1	19.5	17.8	+1.7

Comparative observations of Atmospheric Humidity at heights of 6 and 46 feet above the ground at Allahabad Observatory.

MONTH.			VAPOUR TENSION IN INCHES OF MERCURY.						RELATIVE HUMIDITY OR PERCENTAGE OF SATURATION.											
			5 $\frac{5}{8}$ H.			13 $\frac{5}{8}$ H.			21 $\frac{5}{8}$ H.			5 $\frac{5}{8}$ H.			13 $\frac{5}{8}$ H.			21 $\frac{5}{8}$ H.		
			Lower cage (6 ft.)	Upper cage (46 ft.)	Differ-ence.	Lower cage (6 ft.)	Upper cage (46 ft.)	Differ-ence.	Lower cage (6 ft.)	Upper cage (46 ft.)	Differ-ence.	Lower cage (6 ft.)	Upper cage (46 ft.)	Differ-ence.	Lower cage (6 ft.)	Upper cage (46 ft.)	Differ-ence.	Lower cage (6 ft.)	Upper cage (46 ft.)	Differ-ence.
April	.	.	.319	.337	-.019	.196	.203	-.007	.331	.326	+.005	.38	.37	+.1	10	11	-1	28	25	+3
May	.	.	.622	.630	-.008	.495	.489	+.006	.590	.596	-.006	.61	.60	+.1	27	28	-1	45	42	+3
June	.	.	.792	.756	+.036	.745	.691	+.054	.778	.730	+.048	.70	.67	+.03	.46	.44	+.2	61	57	+4
July	.	.	.982	.960	+.022	.984	.928	+.056	.990	.963	+.027	.94	.92	+.02	.76	.74	+.2	90	87	+3
August	.	.	.938	.924	+.014	.946	.891	+.055	.963	.940	+.023	.93	.92	+.01	.72	.70	+.2	88	85	+3
September	.	.	.808	.886	+.072	.877	.818	+.059	.941	.901	+.040	.93	.92	+.01	.66	.63	+.3	90	84	+6
October	.	.	.788	.793	-.005	.734	.694	+.040	.803	.756	+.047	.93	.90	+.03	.61	.57	+.4	87	7	+10
November	.	.	.460	.465	-.005	.400	.361	+.039	.498	.444	+.054	.87	.79	+.08	.39	.34	+.5	76	58	+18
December	.	.	.360	.375	-.006	.372	.341	+.031	.415	.396	+.019	.88	.82	+.06	.49	.44	+.5	82	68	+14
January 1887	.	.	.348	.352	-.004	.355	.326	+.029	.393	.375	+.018	.90	.86	+.04	.52	.47	+.5	83	72	+11
February	.	.	.286	.256	+.030	.230	.177	+.053	.310	.249	+.061	.73	.57	+.16	.26	.19	+.7	56	38	+18
March	.	.	.363	.328	+.035	.277	.208	+.069	.358	.276	+.082	.60	.49	+.11	.21	.16	+.5	29	29	+14
Year	.	.	.597	.588	+.009	.551	.511	+.040	.615	.579	+.036	.78	.74	+.04	.45	.42	+.3	69	60	+9

Comparison of Shade temperatures at the new Observatory, Chatham Lines, Allahabad, with those simultaneously recorded at the old site.

[Means of two years' observations.]

MONTH.	AT 10 H.			AT 16 H.			MAXIMUM.			MINIMUM.			MEAN.	
	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.
January	64.6	62.9	+1.7	72.6	71.0	+1.6	73.5	73.2	+0.3	48.8	49.2	-0.4	60.2	59.6
February	67.1	65.8	+1.3	76.7	76.0	+0.7	77.6	77.8	-0.2	48.5	48.6	-0.1	62.1	61.7
March	82.6	82.0	+0.6	90.7	90.2	+0.5	91.9	92.6	-0.7	62.2	62.0	+0.2	76.6	76.4
April	92.8	93.3	-0.5	100.4	100.1	+0.3	101.8	102.9	-1.1	71.0	70.7	+0.3	86.2	86.2
May	94.8	95.4	-0.6	101.8	101.6	+0.2	103.2	104.5	-1.3	76.6	76.6	0	90.0	90.3
June	94.4	94.8	-0.4	99.2	99.2	0	101.2	102.3	-1.1	82.4	82.4	-0.2	91.2	91.5
July	85.4	85.2	+0.2	88.1	87.4	+0.7	90.2	90.4	-0.2	79.0	79.0	0	84.0	83.8
August	84.2	83.8	+0.4	86.2	85.6	+0.6	88.3	88.5	-0.2	78.2	77.9	+0.3	82.4	82.3
September	85.9	85.2	+0.7	88.7	87.5	+1.2	91.0	90.4	+0.6	76.6	76.4	+0.2	82.6	82.0
October	82.2	80.5	+1.7	87.9	85.0	+2.9	92.6	91.8	+0.8	66.2	66.2	0	76.8	75.7
November	74.0	71.1	+2.9	80.8	77.4	+3.4	81.8	81.0	+0.8	52.9	53.2	-0.3	66.1	61.8
December	64.3	62.9	+1.4	71.2	69.0	+2.2	71.8	71.7	+0.1	48.4	49.2	-0.8	59.0	58.5
Mean	81.0	80.2	+0.8	87.0	85.8	+1.2	88.7	88.9	-0.2	65.9	66.0	-0.1	75.6	75.2
														+0.4

Comparative observations of Vapour Tension for two years at the old and new Observatories, Allahabad.

VAPOUR TENSION IN INCHES OF MERCURY.

MONTH.	MEAN.*			AT 10 A.M.			AT 4 P.M.			FROM MINIMA.		
	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.
January	.356	.373	-.017	.382	.382	0	.362	.399	-.037	.325	.339	-.014
February	.254	.296	-.042	.265	.292	-.027	.238	.302	-.064	.258	.296	-.038
March	.388	.401	-.013	.412	.420	-.008	.373	.378	-.005	.378	.404	-.026
April	.387	.442	-.055	.418	.468	-.050	.302	.417	-.055	.382	.442	-.060
May	.532	.543	-.011	.560	.561	-.001	.471	.481	-.010	.565	.586	-.021
June	.727	.723	+0.004	.714	.738	-.024	.698	.693	+0.005	.738	.738	0
July	.948	.972	-.024	.995	.995	0	.988	.988	0	.917	.932	-.015
August	.930	.949	-.019	.938	.960	-.022	.956	.974	-.033	.910	.914	-.004
September	.874	.906	-.032	.912	.936	-.024	.865	.916	-.051	.846	.865	-.019
October	.588	.636	-.048	.644	.644	0	.553	.657	-.104	.582	.609	-.027
November	.365	.408	-.043	.426	.426	0	.348	.438	-.090	.354	.386	-.032
December	.349	.376	-.027	.381	.381	0	.352	.410	-.058	.324	.338	-.014
Year	.558	.585	-.027	.583	.600	-.017	.543	.588	-.045	.548	.570	-.022

* Crude mean of 10 A.M., 4 P.M., and minimum observations.

Comparative observations of Atmospheric Humidity for two years at the old and new Observatories, Allahabad.

RELATIVE HUMIDITY OR PERCENTAGE OF SATURATION.												
MONTH.	MEAN.*			AT 10 A.M.			AT 4 P.M.			FROM MINIMA.		
	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.
January	66	72	-6	62	66	-4	45	52	-7	92	96	-4
February	47	54	-7	40	46	-6	26	32	-6	74	84	-10
March	43	47	-4	38	40	-2	26	28	-2	66	73	-7
April	33	37	-4	28	30	-2	20	22	-2	50	58	-8
May	41	42	-1	36	35	+1	24	24	0	62	64	-2
June	54	53	+1	50	49	+1	43	42	+1	68	68	0
July	81	84	-3	80	82	-2	73	77	-4	90	94	-5
August	83	86	-3	80	83	-3	76	80	-4	94	95	-1
September	77	81	-4	74	78	-4	66	71	-5	92	94	-2
October	64	70	-6	58	62	-4	43	56	-13	90	94	-4
November	56	64	-8	48	54	-6	33	47	-14	88	93	-5
December	68	74	-6	62	66	-4	48	58	-10	94	96	-2
Year	60	64	-4	55	58	-3	44	49	-5	80	84	-4

* Crude mean of 10 A.M., 4 P.M., and minimum observations.

Comparison of the readings of the Radiation thermometers taken for one or two years at the old and new Observatories, Allahabad.

MONTH.	SOLAR RADIATION THERMOMETER.				NOCTURNAL RADIATION THERMOMETER.			
	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.
January	130.4	134.4	-4.0	38.6	40.6	-2.0	38.6	40.6
February	138.0	139.7	-1.7	30.4	39.0	-8.6	30.4	39.0
March	152.2	154.2	-2.0	50.8	53.4	-2.6	50.8	53.4
April	158.5*	162.3*	-3.8	59.0	61.0	-2.0	59.0	61.0
May	160.1*	163.6*	-3.5	67.6	69.4	-1.8	67.6	69.4
June	159.9*	160.9*	-2.0	76.4	77.4	-1.0	76.4	77.4
July	145.8*	145.3*	+0.5	75.4	77.2	-1.8	75.4	77.2
August	142.8*	140.2*	+2.6	75.8	76.2	-0.4	75.8	76.2
September	149.4*	152.2*	-2.8	73.4	73.0	+0.4	73.4	73.0
October	148.8*	152.3*	-3.5	58.0	59.4	-1.4	58.0	59.4
November	140.2*	146.4*	-6.2	41.4	44.4	-3.0	41.4	44.4
December	126.0	129.8	-3.8	38.4	40.8	-2.4	38.4	40.8
Year	146.0	148.4	-2.4	57.6	59.3	-1.7	57.6	59.3

* One year's observations only.

Comparative observations of Ground temperature for 20 months at the old and new Observatories, Allahabad.

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MONTH.	SURFACE.			ONE FOOT DEPTH.			THREE FEET DEPTH.		
	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.
January	60.6	63.3	-2.7	61.0	66.2	-5.2	65.1	69.3	-4.2
February	63.6	68.3	-4.7	65.0	69.2	-4.2	67.6	70.6	-3.0
March	81.4	83.1	-1.7	75.7	80.8	-5.1	73.5	78.0	-4.5
April	89.8	94.4	-4.6	84.6	89.9	-5.3	81.8	85.4	-3.6
May	99.0	98.5	+0.5	92.5	94.2	-1.7	88.3	90.0	-1.7
June	100.1	98.8	+1.3	95.0	95.4	-0.4	92.5	92.6	-0.1
July	87.3	87.4	-0.1	87.4	87.7	-0.3	87.8	87.6	+0.2
August	85.7	85.7	0	85.4	86.2	-0.8	85.7	86.0	-0.3
September*	87.6	87.9	-0.3	86.1	87.6	-1.5	85.5	86.5	-1.0
October*	84.0	85.1	-1.1	81.8	85.6	-3.8	83.7	85.8	-2.1
November*	69.9	75.4	-5.5	72.4	77.8	-5.4	77.4	80.4	-3.0
December*	57.1	62.6	-5.5	63.2	68.2	-5.0	69.6	73.0	-3.4
MEAN	80.5	82.5	-2.0	79.2	82.4	-3.2	79.9	82.1	-2.2

* One year only.

APPENDIX C.

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India during the year 1886-87.

Province.	Observatories.	Class.	Names of Superintendents.	PERIOD.		Names of Observers.	PERIOD.	
				From	To		From	To
BENGAL AND ASSAM.	Sibsagar .	Third	Civil Surgeon .	1st April 1886	31st Mar. 1887	Dandadhar Dutta Barua .	1st April 1886	31st Mar. 1887.
	Dhubri .	Second	Surgeon Edwin Dobson, M.B.	1st April "	31st Mar. "	{ Munshi Kadimuddin Ahmed Boirdya Nath Banerji Munshi Kafayatulla, Asst.	1st April " 23rd Aug. 1886. 24th Aug. " 31st Mar. 1887. 1st April " 31st Mar. "	
	Silchar .	Third	Civil Surgeon .	1st April "	31st Mar. "	Ramesh Chandra Bhadra	1st April "	31st Mar. "
	Tezpur .	Ditto	Ditto	1st April "	31st Mar. "	Mir Sabdar Ali .	1st April "	31st Mar. "
	Patna .	Ditto	Ditto	1st April "	31st Mar. "	Surjan Singh .	1st April "	31st Mar. "
	Hazaribagh .	Ditto	Ditto	1st April "	31st Mar. "	Nuthoo Lal .	1st April "	31st Mar. "
	Saugor Island	Second	.....	.....	.....	{ Mr. R. H. Peters " C. Williams	1st April " 7th Jan. " 8th Jan. 1887 31st Mar. "	
	Cuttack .	Third	.....	.....	.....	{ Mr. H. W. Alley " Frederick Stone	1st April 1886 18th May 1886. 19th May " 31st Mar. 1887.	
	Chittagong .	Ditto	.....	.....	.....	{ Mr. J. E. Gabriel " J. Brown " J. E. Gabriel	1st April " 2nd June 1886. 3rd June " 20th Aug. " 21st Aug. " 31st Mar. 1887.	
	Darjeeling .	Ditto	Rector, St. Paul's School	1st April 1886	31st Mar. 1887	Mr. F. N. Rushton .	1st April "	31st Mar. "
	Purneah .	Ditto	Civil Medical Officer .	1st April "	31st Mar. "	{ Lalit Mohun Banerjee " Gopal Chandra Chandra .	1st April " 30th April 1886 1st May " 31st Mar. 1887.	
	Durbhanga .	Ditto	Civil Surgeon .	1st April "	31st Mar. "	Jogin Chundra Banerjee .	1st April "	31st Mar. "
	Gya .	Ditto	Ditto	1st April "	31st Mar. "	Mukund Lall .	1st April "	31st Mar. "
	Berhampore .	Ditto	Ditto	1st April "	31st Mar. "	Mahendra Nath Roy .	1st April "	31st Mar. "
	Burdwan .	Ditto	Ditto	1st April "	31st Mar. "	Mokhoda Prasad Chowdhury .	1st April "	31st Mar. "
	Jessore .	Ditto	Ditto	1st April "	31st Mar. "	Paresh Nath Roy Chowdhury .	1st April "	31st Mar. "

Dacca	.	.	.	Ditto	.	.....	.....	.....	{ Mr. T. W. DeSouza " T. R. H. Wayne " T. W. DeSouza	.	.	.	1st April 1886 29th Nov. " 8th Dec. "	28th Nov. 1886. 7th Dec. " 31st Mar. 1887.
False Point	.	.	.	Ditto	.	.....	.....	.....	Mr. J. Loudon	.	.	.	1st April "	31st Mar. "
Demagiri	.	.	.	Fourth	.	.....	.....	.....	{ Grish Chundra Bhar Grish Chundra Sirkar Grish Chundra Bhar	.	.	.	1st April " 6th Oct. " 8th Jan. 1887	5th Oct. 1886. 7th Jan. 1887. 31st Mar. "
Mongpoo	.	.	.	Ditto	.	.....	.....	.....	Mr. George A. Gammie	.	.	.	1st April 1886	31st Mar. "
Tura	.	.	.	Ditto	.	Civil Medical Officer	.	1st April 1886	Abdul Marjeem	.	.	.	1st April "	31st Mar. "
Pedong	.	.	.	Third	.	.....	.....	.....	{ Revd. Father A. Desgodins, S.J. " Hervagault, S.J. " A. Desgodins, S.J.	.	.	.	1st April " 8th Feb. 1887 27th Feb. "	7th Feb. " 26th Feb. " 31st Mar. "
Allahabad	.	.	.	First	.	S. A. Hill.	.	1st April 1886	{ Kedar Nath Chatterjee Sashibhusan Banerjee, Asst. Jadu Nath Chatterjee, "	.	.	.	1st April 1886 1st April " 1st April "	31st Mar. " 31st Mar. " 31st Mar. "
Agra	.	.	.	Third	.	{ Dr. A. H. Hilson Dr. G. G. Maclaran	.	1st April " 11th Feb. 1887	Mir Altaf Ali	.	.	.	1st April "	31st Mar. "
Lucknow	.	.	.	Ditto	.	Dr. J. Cleghorn	.	1st April 1886	Chotay Lal	.	.	.	1st April "	31st Mar. "
Roorkee	.	.	.	Ditto	.	Dr. Murray Thomson	.	1st April "	Chirangi Lal	.	.	.	1st April "	31st Mar. "
Chakrata	.	.	.	Ditto	.	{ Captain Digby, R.E. Dickie, R.E. Lieutenant J. Stewart Sergeant W. Chaloner	.	1st April " 1st May " 6th Oct. " 19th Feb. 1887	{ Bunwari Lal Saligram	.	.	.	1st April " 8th Nov. "	7th Nov. 1886. 31st Mar. 1887.
Ranikhet	.	.	.	Ditto	.	.....	.	...	Jewanand	.	.	.	1st April "	31st Mar. "
Dehra	.	.	.	Ditto	.	Deputy Supdt., Survey of India	.	1st April 1886	The computers	.	.	.	1st April "	31st Mar. "
Bareilly	.	.	.	Ditto	.	H. O. Budden, Esq.	.	1st April "	{ Munshi Sunder Lal " Shadi Lal " Sunder Lal " Shadi Lal " Sunder Lal	.	.	.	1st April " 24th May " 2nd June " 16th Feb. 1887 19th Feb. "	23rd May 1886. 1st June " 15th Feb. " 18th Feb. " 31st Mar. "
Meerut	.	.	.	Ditto	.	{ Dr. W. Moir. J. R. Stuart Dr. W. Moir	.	1st April " 31st May " 1st July "	Harsaran Das.	.	.	.	1st April 1886	31st Mar. 1887.
Gorakhpur	.	.	.	Ditto	.	{ Dr. C. Prentis. " T. M. Sullivan " C. Prentis " Jageswar Roy " W. A. D. Fasken	.	1st April " 11th Oct. " 10th Nov. " 9th Jan. 1887 20th Jan. "	Nizam Uddin	.	.	.	1st April "	31st Mar. 1886.

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India during the year 1886-87—contd.

Province.	Observatories.	Class.	Names of Superintendents.	Period.		Names of Observers.	Period.	
				From	To		From	To
N. W. PROVINCES AND ODH—continued.	Ghazipur . . .	Third	{ Dr. P. A. Weir Mr. G. M. Gregory . . . Dr. P. A. Weir . . .	1st April 1886 21st Aug. " 11th Nov. "	20th Aug. 1886 10th Nov. " 31st Mar. 1887	{ Mahabir . . . Pandit Ram Ratan Pathak .	1st April 1886 1st April "	31st Mar. 1887. 31st Mar. "
	Benares . . .	Ditto	Dr. G. Thibaut . . .	1st April "	31st Mar. "	{ Kalka Das Behari Lal . . .	1st April 16th Sept. "	15th Sept. 1886. 31st Mar. 1887.
	Jhansi . . .	Ditto	Surgeon C. P. Lukis . . .	1st April "	31st Mar. "	Sher Sing . . .	1st April "	31st Mar. "
	Pithoragarh . . .	Ditto	Dr. S. Dease, M.D. . . .	1st April "	31st Mar. "	{ Mr. H. G. Shaw, <i>Acting observer</i> Nirbhai Sing, <i>Asst.</i> .	1st April 31st Oct "	31st Mar. " 31st Mar. "
	Mussooree . . .	Ditto	Dy. Surveyor-Genl. in charge Trigonometrical Surveys.	1st April "	31st Mar. "	Jasput Roy . . . Divan Chand, <i>Asst.</i> . Budha Mull, " . . .	1st April 1st April 1st April "	31st Mar. " 31st Mar. " 31st Mar. "
	Lahore . . .	Second	{ J. C. Oman, Esq. Dr. Dickson . . . J. C. Oman, Esq. . .	1st April 2nd Aug. " 14th Oct "	1st Aug. 1886 13th Oct. " 31st Mar. 1887	{ Wahid Ali Ram Ditta . . .	1st April 1886 29th April "	28th Apl. 1886. 31st Mar. 1887.
	Mooltan . . .	Third	{ Dr. Sahib Ditta Mull Surgeon A. M. Crafts Dr. Sahib Ditta Mull Surgeon J. A. Cunningham	1st April 1886 25th April " 25th July " 10th Nov. "	24th Apl. 1886 24th July " 9th Nov. " 31st Mar. 1887	{ Noor Bukhsh . . . Kashi Ram . . .	1st April 1st April "	31st Mar. " 31st Mar. "
	Dera Ismail Khan . . .	Ditto	{ Surgeon C. McCarrie " G. W. P. Dennys . " J. J. Pratt . . .	10th Apl. 1886 25th Nov. " 26th Feb. 1887	24th Nov. 1886 25th Feb. 1887 31st Feb. "	{ Kalee Nath Rai . . . Mr. W. Cruickshank . . .	1st April 1st April "	31st Mar. " 31st Mar. "
	Peshawar . . .	Ditto	{ Dr. G. F. Nicholson, " F. C. Chatterjee . " G. F. Nicholson, " E. S. Brander . . .	1st April 1886 1st July " 30th Sept. " 16th Mar. 1887	30th June 1886 20th Sep. " 15th Mar. 1887 31st Mar. "	{ Kalee Nath Rai . . . Mr. W. Cruickshank . . .	1st April 1st April "	31st Mar. " 31st Mar. "
	Rawalpindi . . .	Ditto	{ Dr. G. Massy . . . " Brander . . . " G. Massy . . . " Rae . . . " G. Massy . . .	1st April 1886 5th May " 5th June " 28th Nov. " 8th Mar. 1887	4th May 1886 4th June " 27th Nov. " 7th Mar. 1887 31st Mar. "	{ Kalee Nath Rai . . . Mr. W. Cruickshank . . .	1st April 1st April "	31st Mar. " 31st Mar. "
Murree . . .	Ditto	Rev. G. C. Peake . . .	1st April 1886	31st Mar. 1887	{ Kalee Nath Rai . . . Mr. W. Cruickshank . . .	1st April 1st April "	31st Mar. " 31st Mar. "	
Sialkot . . .	Ditto	{ Assistant Surgeon Fattah Singh Dr. G. W. P. Devys . . . Assistant Surgeon Mehr Chand .	1st April 1886 19th April " 25th Oct. "	18th Apl. 1886 24th Oct. " 31st Mar. 1887	{ Sirdar Khan . . . Sirdar Khan . . .	1st April 1st April "	31st Mar. " 31st Mar. "	

Ludhiana	Ditto	Dr. Bhugwan Dass	1st April 1886	31st Mar. 1887	{ Brij Lal Bhugwan Dass Brij Lal	1st April 1886 16th Sep. " 16th Dec. " 31st Mar. 1887.
Chamba	Ditto	.....	.....	.....	Dr. Burkhurdar Khan	1st April " 31st Mar. "
Simla	Ditto	Quarter Master General, India	1st April 1886	31st Mar. 1887	Mr. J. J. Konigs	1st April " 31st Mar. "
Kailang	Ditto	Rev. A. W. Heyde	1st April "	31st Mar. "	Mr. J. Danna	1st April " 31st Mar. "
Delhi	Ditto	{ Dr. T. E. L. Bate Malik Jawalashai Dr. D. N. P. Ditta " T. E. L. Bate	1st April " 1st Sep. " 11th Sep. " 23th Oct. "	31st Aug. 1886 10th Sep. " 24th Oct. " 31st Mar. 1887	{ Pundit Bansee Dhar	1st April " 31st Mar. "
Sirsa	Ditto	.....	.....	.....	Chander Bhan	1st April " 31st Mar. "
Nagpur	Second	{ Surgeon-Major R. T. Wright, M.D. A. B. Marriott, Esq. Surgeon-Major B. Evers, M.D.	1st April 1886 17th Nov. " 24th Nov. " 13th Dec. "	16th Nov. 1886 23rd Nov. " 14th Dec. " 31st Mar. 1887	{ P. Soobiah Abed Hossain, Asst. Varadarajooloo	1st April " 1st April " 10th Nov. " 31st Mar. " 9th Nov. 1886. 31st Mar. 1887.
Jubbulpore	Ditto	{ Brigade-Surgeon W. R. Rice, M.D. Surgeon-Major W. H. Booth " S. H. Browne, M.D. Brigade-Surgeon W. R. Rice, M.D.	1st April " 4th Aug. " 10th Aug. " 6th Nov. "	3rd Aug. 1886 9th Aug. " 5th Nov. " 31st Mar. 1887	Sadhuram Dubey Ramlogan Sing, Asst. Yogambaram Ramlogan Sing	1st April " 1st April " 3rd Aug. " 22nd Oct. " 31st Mar. " 2nd Aug. 1886. 21st Oct. " 31st Mar. 1887.
Pachmarhi	Ditto	{ Surgeon-Major R. Drury " E. Fairland	1st April " 1st March 1887	28th Feb. " 31st Mar. "	{ T. M. Venkatachalem Pillay Pundit Kesho Rao P. Raja Ratnam, Asst. T. M. Venkatachalem Pillay, Asst. P. Raja Ratnam Probationer A. Runga Naikooloo	1st April " 1st June " 1st April " 1st June " 7th June " 17th July " 1st Oct. " 31st Mar. 1887.
Saugor	Third	Surgeon-Major J. B. Gaffney	1st April 1886	31st Mar. "	Jadu Nath Bose	1st April " 31st Mar. "
Hoshangabad	Ditto	{ Surgeon C. Henderson Surgeon-Major B. Evers, M.D. Surgeon C. Henderson Surgeon-Major G. R. Daphtary	1st April " 2nd Dec. " 10th Dec. " 7th March 1887	1st Dec. 1886 9th Dec. " 6th Mar. 1887 31st Mar. "	{ Krishnajeet T. M. Venkatachalem Pillay	1st April " 10th June " 9th June 1886. 31st Mar. 1887.
Khandwa	Ditto	{ Surgeon-Major S. H. Browne " B. Evers, M.D. " P. Cullen, M.D.	1st April 1886 9th Aug. " 28th Nov. "	8th Aug. 1886 27th Nov. " 31st Mar. 1887	{ Behari Lal Rajaram	1st April " 13th Mar. 1887 12th Mar. " 31st Mar. "
Seoni	Ditto	{ Surgeon-Major H. K. McKay Sheik Shabrati Assistant Surgeon Upendra Nath Chatterji Surgeon-Major H. K. McKay	1st April " 4th May " 7th May " 17th Aug. "	3rd May 1886 6th May " 16th Aug. 1886 31st Mar. 1887	{ Punchum	1st April 1886 31st Mar. "

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India during the year 1886-87—contd.

Province.	Observatories.	Class.	Names of Superintendents.	PERIOD.		Names of Observers.	PERIOD.	
				From	To		From	To
CENTRAL PROVINCES—contd.	Chanda . . .	Third . . .	Surgeon-Major B. Evers, M.D. . . Assistant Surgeon Kshettra Pal Chakravarti . . . Assistant Surgeon Shib Chundra-Bhattacharji . . . Assistant Surgeon Nriya Lal Basack . . . Assistant Surgeon Omesh Chundra Mitra . . .	1st April 1886 7th Augt. " 2nd Sept. " 8th Feb. 1887 29th Mar. , ,	6th Aug. 1886 1st Sept. " 7th Feb. 1887 28th Mar. " 31st Mar. "	Seetaram Narayan . . .	1st April 1886	31st Mar. 1887.
	Sironcha . . .	Ditto . . .	Narahar Govind . . . Observatory closed . . .	1st April 1886 21st Nov. "	20th Nov. 1886 31st Mar. 1887	P. Muthra Krishna Naidoo . . .	1st April "	20th Nov. 1886.
	Raipur . . .	Ditto . . .	Brigade Surgeon D. W. Trimmell . . .	1st April "	31st Mar. "	Govind Ramchandra . . .	1st April "	31st Mar. 1887.
	Sambalpur . . .	Ditto . . .	Surgeon J. L. Poynder . . .	1st April "	31st Mar. "	Anantram Behra . . .	1st April "	31st Mar. "
BERAR.	Akola . . .	Ditto . . .	Surgeon J. J. Moran, M.D. . . Apothecary W. Hendricks . . . Surgeon J. J. Moran, M.D. . . Apothecary D. Callaghan . . .	1st April " 4th May " 26th June " 2nd Dec. "	3rd May. 1886 25th June " 1st Dec. " 31st Mar. 1887	Mr. Samuel Gregory . . .	1st April "	31st Mar. "
	Buldana . . .	Ditto . . .	Apothecary D. Callaghan . . . Surgeon J. J. Moran, M.D. . .	1st April " 5th Dec. "	29th Nov. 1886 31st Mar. 1887	Wamon Pandurang . . . Luxmon Vinayek . . .	1st April " 1st May "	30th April 1886. 31st Mar. 1887.
	Chikalda . . .	Ditto . . .	Surgeon F. J. Doyle . . . Apothecary W. Hendricks . . .	1st April " 21st Mar. 1887	20th Mar. " 31st Mar. "	Hiralal . . . Raja Ruthnum . . .	1st April " 1st May "	30th April 1886. 31st Mar. 1887.
	Amraoti . . .	Ditto . . .	Surgeon J. Hume, M.B. . . " R. B. Rae . . .	1st April 1886 2nd May "	1st May 18 6 31st Mar. 1887	Bukaram Pandurang . . . S. Nursappa . . . Bukaram Pandurang . . .	1st April " 18th May " 26th May "	17th May 1886. 25th May " 31st Mar. 1887.
Mysore.	Makhlia . . .	Fourth . . .	J. Balantine . . .	1st April "	31st Mar. "	Papanah . . .	1st April "	1st Mar. "
	Jeypore . . .	First . . .	Surgeon-Major T. H. Hendley . . .	1st April "	31st Mar. "	Durga Pershad . . . Nathoo Narain, Asst. . . Sheo Pertab, " . . .	1st April " 1st April " 1st April "	31st Mar. " 31st Mar. " 31st Mar. "
	Sutna . . .	Third . . .	Dr. S. J. Goldsmith . . .	1st April "	31st Mar. "	Harnath . . . Heera Lal . . . Harnath . . .	1st April " 23rd April " 3rd May "	22nd April 1886. 2nd May " 31st Mar. 1887.
	Nowgong . . .	Ditto . . .	John Mather . . .	1st April "	31st Mar. "	Baldeo Pershad . . .	1st April "	31st Mar. "

Neemuch	Ditto	Surgeon D. O'Connell Dr. H. Waghorn No Superintendent Dr. H. Waghorn	1st April 1886 9th Nov. " 20th Dec. " 16th Jan. 1887	8th Nov. 1886 25th Dec. " 15th Jan. 1887 31st Mar. "	T. Bachoo Mahadeb R. Gupte Babu Kison Sing	1st April 1886 1st Mar. 1887 13th Mar. "	28th Feb. 1887. 12th Mar. " 31st Mar. "
Indore	Ditto	Surgeon-Major R. Caldecatt " D. F. Kegan, M.D.	1st April 1886 24th Mar. 1887	23rd Mar. " 31st Mar. "	Trimbakrao	1st April 1886	31st Mar. "
Mount Abu	Ditto	Surgeon-Major A. F. Preston, M.B. " H. F. Bunett	1st April 1886 26th Dec. "	25th Dec. 1886 31st Mar. 1887	M. M. Talati	1st April "	31st Mar. "
Pachpadra	Ditto	Mr. G. A. Bradford	1st April "	31st Mar. "	Mr. P. Halder	1st April "	31st Mar. "
Ajmere	Ditto	Surgeon-Major J. H. Newman Surgeon J. Crofts, M.D.	1st April " 24th June "	23rd June 1886 31st Mar. 1887	Ram Pershad	1st April "	31st Mar. "
Sambhar	Ditto	A. F. Ashton, Esq.	1st April "	31st Mar. "	Habib-ullah Khan	1st April "	31st Mar. "
Bickaneer	Ditto	.....	.....	.....	Luchmon Dass	1st April "	31st Mar. "
Belgaum	Second.	Surgeon-Major R. P. Ferguson	1st April 1886	31st Mar. 1887	Ram Chandra Datta Balaji K. Gunjakal, Asst.	1st April " 1st April "	31st Mar. " 31st Mar. "
Yerrowda (Poona)	Ditto	Surgeon-Major S. M. Solomon	1st April "	31st Mar. "	Narayan S. Kelkar Govindraj Coopu Swamy, Asst. M. Masilmony Modelier, " Ganesh Pandurang Sawarker, "	1st April " 1st April " 7th June " 13th Aug. "	31st Mar. " 6th June 1886. 12th Aug. " 31st Mar. 1887.
Deesa	Ditto	Surgeon-Major W. P. Bridges	1st April "	31st Mar. "	Doyal Bhala Ramkrishna Keshav. Doyal Bhala, Asst.	1st April " 10th April " 1st April "	9th April 1886. 31st Mar. 1887. 31st Mar. "
Kurrachee	Ditto	Brigade Surgeon C. H. Girard, L.M.S.	1st April "	31st Mar. "	Minguel Fernandez Husson Kadar, Asst.	1st April " 1st April "	31st Mar. " 31st Mar. "
Jacobabad	Third	Surgeon H. Adey " H. W. Stevenson " H. Adey	1st April " 1st Oct. " 11th Jan. 1887	30th Sep. 1886 10th Jan. 1887 31st Mar. "	Shaik Ali	1st April "	31st Mar. "
Hyderabad (Sind)	Ditto	Surgeon-Major H. De Tatham, M.S. Surgeon B. N. Koyajee Surgeon-Major B. C. Keelan	1st April 1886 13th May " 19th May "	12th May 1886 18th May " 31st Mar. 1887	Hussein Khan Nasservanjee Hussein Khan	1st April " 19th June " 20th Dec. "	18th June 1886. 19th Dec. " 31st Mar. 1887.
Bhuj	Ditto	Surgeon-Major F. Jones Surgeon C. J. Sarkies, M.B.	1st April " 1st Jan. 1887	12th Nov. 1886 31st Mar. 1887	Sankarji Naronji Vora	1st April "	31st Mar. "
Rajkot	Ditto	Surgeon-Major James S. Wilkins F. C. Barker " P. J. Damania	1st April 1886 1st June " 28th Mar. 1887	31st May 1886 27th Mar. 1887 31st Mar. "	Bhabani Prosad Bhagvanlal	1st May "	31st Mar. "
Sholapur	...	W. R. Scroggie, Esq., L.R.C.P.	1st April 1886	31st Mar. 1887	Balwant Laksman	1st April "	31st Mar. "

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India during the year 1886-87—contd.

Province.	Observatories.	Class.	Names of Superintendents.	PERIOD.		Names of Observers.	PERIOD.	
				From	To		From	To
BOMBAY—contd.	Surat . . .	Third . . .	Surgeon-Major S. O. B. Banks . Surgeon D. M. Parakh, I.M.D. . Asst. Surgeon Dassabhai Pestonjee. Surgeon K. S. Nariman, I.M.D. .	1st April 1886 21st April " . 30th May " . 15th Feb. 1887	20th April 1886 29th May " . 14th Feb. 1887 31st Mar. "	{ Chaganlal Horilal . . .	1st April 1886	31st Mar. 1887.
	Malegaon . . .	Ditto . . .	.....	...	...	Shaik Mahomed . . .	1st April "	31st Mar. "
	Ratnagiri . . .	Third . . .	Surgeon H. McColman, M.D. . Assistant Surgeon N. H. E. Sukhia Surgeon H. McColman, M.D. . " M. A. T. Collie, M.B. .	1st April 1886 5th April " . 1st May " . 7th Jan. 1887	4th April 1886 30th April " . 6th Jan. 1887 31st Mar. "	{ Mohadev Cuddum . . .	1st April "	31st Mar. "
	Karwar . . .	Ditto . . .	R. G. C. Westbrook, Esq. .	1st April 1886	31st Mar. "	G. W. M. D. Arango . . .	1st April "	31st Mar. "
BOMBAY—contd.	Bellary . . .	Second . . .	Surgeon T. H. Pope, M.B. . Assistant Surgeon E. L. Chalke, L.M.S. Assistant Surgeon C. Moonisawmy Mudalay, L.M.S.	1st April " . 10th Aug. " . 19th Dec. "	9th Aug. 1886 18th Dec. " . 18th Feb. 1887	{ B. G. Sashachellam Naidu . A. Sreenivasa Row . . . P. Namasivayam Pillay . . . Mr. J. T. Williams . . . P. Namasivayam Pillay . . . C. Sadagopa Moodliar . . . A. Sreenivasa Row, Asst. . I. M. Lutchmupathy Naidu " . A. Sreenivasa Row " .	1st April " . 20th May " . 29th May " . 22nd July " . 29th Aug. " . 22nd Oct. " . 1st April " . 16th Aug. " . 1st Jan. 1887.	10th May 1886. 28th May " . 21st July " . 28th Aug. " . 21st Oct. " . 31st Mar. 1887. 15th Aug. 1886. 31st Dec. " . 31st Mar. 1887.
HYDRABAD.	Trichinopoly . . .	Ditto . . .	Surgeon-Major H. Hyde . . . " L. C. Nanney . . .	1st April 1886 27th Oct. "	26th Oct. 1886 31st Mar. 1887	{ T. Lutchman Row . . . G. Narayanasawmy Naidu . T. Lutchman Roy . . . E. R. Sathoo Roy, Asst. .	1st April 1886 7th Feb. 1887. 6th Mar. " . 1st April 1886	6th Feb. " . 5th Mar. " . 31st Mar. " . 31st Mar. "
	Gopalpore . . .	Ditto . . .	Port Officer . . .	1st April "	31st Mar. 1887	J. Samasirow Naidu . . .	1st April "	31st Mar. "
	Masulipatam . . .	Third . . .	Surgeon-Major J. B. Thomas, L.R. C.P.L. Assistant Surgeon A. Guru Sing, B.A., M.B., M.C. Assistant Surgeon H. F. Stauntow, M.B., M.C.	1st April " . 26th April " . 15th Nov. "	25th April 1886 14th Nov. " . 31st Mar. 1887	{ M. C. Lutchmeepathy Naidu . . . A. Sreenivasa Row . . . I. Sreenivasa Row . . .	1st April " . 6th Sep. " . 1st Jan. 1887	5th Sep. 1886. 31st Dec. " . 31st Mar. 1887.

Secunderabad	Ditto	<p>Surgeon-Major T. C. H. Spencer.</p> <p>Surgeon M. J. Kelawala</p> <p>" E. R. Dacosta</p> <p>Surgeon-Major T. C. H. Spencer.</p> <p>Surgeon W. F. Thomas</p> <p>" F. R. Devicha</p> <p>Surgeon-Major T. J. H. Wilkins</p> <p>Surgeon F. R. Devicha</p>	<p>1st April 1886</p> <p>5th April "</p> <p>1st June "</p> <p>6th June "</p> <p>12th June "</p> <p>9th Sept. "</p> <p>7th Oct. "</p> <p>17th Oct. "</p>	<p>4th April 1886</p> <p>31st May "</p> <p>5th June "</p> <p>11th June "</p> <p>8th Sep. "</p> <p>6th Oct. "</p> <p>16th Oct. "</p> <p>31st Mar. 1887.</p>	<p>J. T. Williams</p> <p>B. G. Sashachellum Naidu</p> <p>J. T. Williams</p>	<p>1st April 1886</p> <p>22nd July "</p> <p>1st Sep. "</p>	<p>21st July 1886.</p> <p>31st Aug. "</p> <p>31st Mar. 1887.</p>
Kurnool	Ditto	<p>S. H. Wynne, Esq., B.A., C.S.</p> <p>G. E. Campbell, Esq., C.S.</p> <p>W. G. Underwood, Esq., C.S.</p> <p>E. C. Johnson, Esq., C.S.</p> <p>C. Kough, Esq., C.S.</p>	<p>1st April "</p> <p>5th May "</p> <p>17th May "</p> <p>18th June "</p> <p>26th July "</p>	<p>4th May 1886.</p> <p>16th May "</p> <p>17th June "</p> <p>25th July "</p> <p>31st Mar. 1887.</p>	<p>S. V. Varadarajuloo Naidu</p>	<p>1st April "</p>	<p>31st Mar. "</p>
Cuddapah	Ditto	<p>Surgeon M. Jyasawmy</p>	<p>1st April "</p>	<p>31st Mar. "</p>	<p>V. A. Vijiravaloo Moodeliar</p>	<p>1st April "</p>	<p>31st Mar. "</p>
Bangalore	Ditto	<p>Surgeon-Major A. F. Dobson, M.B.</p>	<p>1st April "</p>	<p>31st Mar. "</p>	<p>Rungasawmy Moodeliar</p>	<p>1st April "</p>	<p>31st Mar. "</p>
Negapatam	Ditto	<p>1st Grade Assistant Apothecary H.A. Henderson.</p>	<p>1st April "</p>	<p>31st Mar. "</p>	<p>S. Saminatha Iyer</p>	<p>1st April "</p>	<p>31st Mar. "</p>
Salem	Ditto	<p>Assistant Surgeon M. Thummung, M.D.</p> <p>Surgeon-Major Hazlett</p> <p>Surgeon H. St. Carruthers</p>	<p>1st April "</p> <p>1st Oct. "</p> <p>21st Jan. 1887</p>	<p>30th Sep. 1886</p> <p>20th Jan. 1887</p> <p>31st Mar. "</p>	<p>L. Ramsingh</p>	<p>1st April "</p>	<p>31st Mar. "</p>
Coimbatore	Ditto	<p>Surgeon-Major J. F. Fitzpatrick, M.D.</p>	<p>1st April 1886</p>	<p>31st Mar. "</p>	<p>C. S. Saminatha Pillay</p>	<p>1st April "</p>	<p>31st Mar. "</p>
Madura	Ditto	<p>Surgeon F. C. Smith</p> <p>Surgeon H. St. Carruthers</p> <p>Surgeon F. C. Smith</p>	<p>1st April "</p> <p>4th July "</p> <p>5th Jan. 1887</p>	<p>3rd July 1886</p> <p>4th Jan. 1887</p> <p>31st Mar. "</p>	<p>G. R. Paramaswara Iyer</p>	<p>1st April "</p>	<p>31st Mar. "</p>
Calicut	Ditto	<p>Captain F. M. Gillham</p>	<p>1st April 1886</p>	<p>31st Mar. "</p>	<p>Mr. Felix D. Rozario</p>	<p>1st April "</p>	<p>31st Mar. "</p>
Cochin	Ditto	<p>Brigade Surgeon W. H. Morgan</p> <p>2nd Grade Apothecary O. W. Jones</p> <p>Surgeon-Major T. C. H. Spencer</p> <p>Civil Apothecary G. W. Leach</p>	<p>1st April "</p> <p>19th May "</p> <p>24th June "</p> <p>17th Sep. "</p>	<p>18th May 1886</p> <p>23rd June "</p> <p>16th Sep. "</p> <p>31st Mar. 1887</p>	<p>M. V. Eippe</p>	<p>1st April "</p>	<p>31st Mar. "</p>
Wellington	Ditto	<p>Surgeon-Major W. Keir</p>	<p>1st April "</p>	<p>31st Mar. "</p>	<p>Mr. H. Brownell</p>	<p>1st April "</p>	<p>31st Mar. "</p>
Mercara (Post Office).	Ditto	<p>Surgeon-Major Mark Robinson</p>	<p>1st April "</p>	<p>31st Mar. "</p>	<p>S. V. Kristiniah</p> <p>M. Annappah</p>	<p>1st April "</p> <p>1st Jan. 1887</p>	<p>31st Dec. 1886.</p> <p>31st Mar. 1887.</p>
Mercara (Civil Dispensary).	Ditto	<p>Ditto</p>	<p>1st Jan. 1887</p>	<p>31st Mar. "</p>	<p>S. V. Kristiniah</p>	<p>1st Jan. 1887</p>	<p>31st Mar. "</p>

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India during the year 1886-87—concl'd.

Province.	Observatories.	Class.	Names of Superintendents.	PERIOD.		Names of Observers.	PERIOD.	
				From	To		From	To
MADRAS, MYSORE AND HYDERABAD—cont'd.	Mangalore . .	Third . .	Captain N. N. W. Hamilton .	7th Oct. 1886	31st Mar. 1887	{ Mr. S. J. Croning . . " E. D. Rozario . .	1st April 1886 1st Oct. "	30th Sep. 1886. 31st Mar. 1887.
	Rejahmundry . .	Ditto . .	{ Surgeon-Major E. Levinge . Assistant Surgeon W. J. Hadden . " J. Lychlander .	1st April " 1886 10th Sep. " 1887 17th Mar. 1887	9th Sept. 1886 10th Mar. 1887 31st Mar. "	A. Mukanda Row Naidu .	1st April 1886	31st Mar. 1887.
	Coconada . .	Ditto . .	Port Officer	1st April 1886	31st Mar. "	C. J. M. Gaetane	1st April 1886	31st Mar. 1887.
	Rangoon . .	Second . .	{ Surgeon-Major H. Johnstone . Brigade Surgeon H. Griffith . Surgeon-Major O. Baker .	1st April " 1886 3rd Aug. " 1887 21st Aug. "	2nd Aug. 1886 20th Aug. " 31st Mar. 1887	{ Mr. G. E. Wales . . U. Gyan C. Boog Isan Hla, Assts. . Mr. H. White, . Chit Maung, " .	1st April 1886 1st June " 1886 1st July " 1887 1st April " 1886 1st June " 1886 1st Oct. " 1887 1st Nov. " 1887	31st May 1886. 30th June " 31st Mar. 1887. 31st May 1886. 31st Oct. " 31st Mar. 1887.
	Bassein . .	Third . .	Surgeon S. H. Dantra	1st April "	31st Mar. 1887	Maung Pe	1st April 1886	31st Mar. 1887.
BURMAH.	Diamond Island . .	Ditto . .	.....	.....	.....	{ Mr. F. W. Marsh . . " E. J. Wade . . " F. W. Marsh . .	1st April 1886 13th May " 1886 25th July " 1887	12th May 1886. 24th July " 31st Mar. 1887.
	Akyab . .	Ditto . .	.....	.....	.....	{ Mr. E. B. Atkinson . . " M. McSweeney . . " A. H. Prime . . " M. McSweeney . . " McDonough . .	1st April 1886 13th June " 1886 21st July " 1887 1st Sept. " 1887 1st Nov. " 1887	12th June 1886. 20th July " 31st Aug. " 31st Oct. " 31st Mar. 1887.
	Kindat . .	Ditto . .	.....	.....	.....	{ Surgeon Major G. A. Dundas . " F. J. Drury . . " Major A. B. Strahan . " J. Kernan . . " F. C. Chatterjee . .	9th Oct. 1886 10th Dec. " 1st Jan. 1887 1st Mar. " 1887 6th Mar. "	9th Dec. 1886. 31st Dec. " 28th Feb. " 5th Mar. " 31st Mar. "
	Mandalay . .	Ditto . .	{ Surgeon Major E. Fawcett . . " R. E. Stuart Davis, M.B. . " Major J. McDonnell, . " M.D., F.R.C.S. .	1st April 1886 1st Nov. " 1887 19th Feb. 1887	31st Oct. 1886 18th Feb. 1887 31st Mar. "	{ 1st Grade Hospl. Asst. Yanai- thum. . 1st Grade Hospl. Asst. Am- brose Pillay. . 1st Grade Hospl. Asst. M. Abdool Aziz. .	1st April 1886 1st Nov. " 1st Dec. "	31st Oct. 1886. 30th Nov. " 31st Mar. 1887.

Thayetmyo	Third	Surgeon E. P. Frenchman	1st April 1886	31st Mar. 1887	Alla Deen	1st April 1886	31st Mar. 1887.
Moulmein	Ditto	{ Surgeon-Major O. Baker " G. J. Thomas	1st April 19th Aug. "	18th Aug. 1886 31st Mar. 1887	{ Mr. F. Hilbert	1st April "	31st Mar. "
Mergui	Ditto	Surgeon R. H. Nailer	1st April "	31st Mar. "	Moosajee . . .	1st April "	31st Mar. "
Toungoo	Ditto	Surgeon C. S. Rundie, M.D.	1st April "	31st Mar. "	Sheik Hydiet Ally pital Asst.	1st April "	31st Mar. "
Cocos Island	Ditto	{ ..... .....	..... .....	..... .....	Mr. H. F. Sansom " J. O. Connell	1st April 10th Jan. 1887	9th Jan. 31st Mar. "
Port Blair	Ditto	{ Surgeon-Major W. N. Keefer	1st April 1886	29th Jan. "	Mr. G. T. Carroll	1st April 1886	31st Mar. "
Nancowry	Ditto	{ " A. E. Dalgaurns	1st Feb. 1887	31st Mar. "	{ Mr. S. Thomas Rahmut Oollah Mahomed Abdool Jubbur Shaik Kabeerooddeen Sheopurshun Singh	1st April 11th June 3rd Sept. " 26th Nov " 18th Feb. 1887	10th June 1886. 2nd Sep. " 25th Nov. " 17th Feb. 1887. 31st Mar. "
Leh	Second.	{ Captain Ramsay Rev. F. A. Redslob . . .	1st April 1886 1st Jan. 1887	31st Dec. 1886 31st Mar. 1887	{ Laskyab . Mir Hedar, Asst. Jonathan Droopa, Asst. Mir Hedar . . .	1st April 1886 1st April " 1st Jan. 1887 15th Feb. "	31st Mar. 1887. 31st Dec. 1886. 14th Feb 1887. 31st Mar. "
Aden	Ditto	{ Major F. M. Hunter, C.B., C.S.I. " C. W. H. Sealy " F. M. Hunter, C.B., C.S.I.	1st April 1886 2nd Sep. " 15th Oct. "	1st Sep. 1886 14th Oct. " 31st Mar. 1887	{ Mr. A. W. Abraham " B. C. Cordeiro . " C. F. Dias " B. C. Cordeiro . " B. C. Cordeiro, Asst. " J. Benghiat, " " J. E. Francis, " " C. F. Dias, "	1st April 1886 1st Aug. " 1st Dec. " 1st Mar. 1887 1st April 1886 1st Aug. " 1st Oct. " 1st Mar. 1887	30th June 1886. 30th Nov. " 28th Feb. 1887. 31st Mar. " 31st July 1886. 30th Sept. " 31st Oct. " 31st Mar. 1887.
Bushire	Third	.....	.....	.....	Mr. M. H. Cumming .	1st April 1886	31st Mar. "
Quetta	Ditto	Surgeon-Major J. C. Fullerton, M.B.	1st April 1886	31st Mar. "	{ A. Samuel Pillay Moolchand Agnihotri	1st April 1st June "	31st May 1886. 31st Mar. 1887.
Katmandu	Ditto	.....	.....	.....	{ Mahamud Hussain . Taraprossono Mookerji Mahamud Hussain .	1st April 7th Nov. " 22nd Dec. "	6th Nov. 1886. 21st Dec. " 31st Mar. 1887.
Amini Divi	Ditto	.....	.....	.....	{ Syed Laul Mr. J. D'Cruze	1st April 10th May "	9th May 1886. 31st Mar. 1887

APPENDIX D.

Return of the Stock, Receipt, and Issue of Instruments for the year 1886-87.

INSTRUMENTS.	In store on 1st April, 1886.	Received, 1886-87.	Issued, 1886-87.
Barometer, observatory, Fortin's principle	12	11	11
„ „ Kew „	2	9	3
„ mountain portable tripod (Adie)	20	9	15
„ marine, Kew principle	20	1	1
„ Newman's large standard	2	...	1
„ „ small „	3	...	3
„ Negretti and Zambra (various)	13	1	6
Aneroids	17	1	2
Hick's barograph	1	...	...
Thermometers, standard, with attached scales	9	3	1
„ for hygrometers (Kew pattern)	30	67	52
Sling thermometers	3	12	1
Chemical „ . . . . .	...	6	...
Thermometers, maximum, for shade	55	26	34
„ solar in vacuo (self-registering)	17	28	28
„ „ (non-self-registering)	16	10	...
„ not in vacuo	2	...	...
„ minimum, for shade	28	60	61
„ „ for radiation	21	28	17
Six's thermometers	7	...	...
Traveller's maximum and minimum thermometers	6	...	...
Frankland's sun thermometers	3	...	...
Boiling-point thermometers	7	...	...
Thermograph, with Negretti and Zambra's sets of recording thermometers	1	...	...
Common thermometers, brass scales	26	...	26
Ponillet's pyrheliometer	1	...	...
Stewart's actinometers (thermometers for)	7	...	...
„ „ (chamber for)	1	...	...
Hodgkinson's actinometers	2	...	...
Herschell's „	1	...	...
Glass tube . . . . .	...	36	36
Regnault's hygrometers	3	...	...
Daniel's „	10	...	...
Halleur's „	5	...	...

Return of the Stock, Receipt, and Issue of Instruments for the year 1886-87—concluded.

INSTRUMENTS.	In store on 1st April, 1886.	Received, 1886-87.	Issued, 1886-87.
Pocket spectroscopes (Browning's)	1	...	...
Anemometers	7	49	31
Wind vanes	2	44	30
Beckley's anemograph	1	2	...
Casella's	2	...	...
Draper's self-recording sun thermometers	...	1	...
Electrical anemometer and wind vanes	3	...	...
Raingauges (Symons's), 5" diameter	38	6	9
" " 6" "	1	...	...
" " 8" "	...	3	2
Self-registering raingauges (Casella's)	1	...	1
Measure glasses for 5" Raingauges	1	55	12
" " 6" "	2	...	1
" " 8" "	...	5	2
Reading lenses	1	10	10
Sun thermometer stands	11	...	1
Radiation pads	...	16	8
Thermometer cages	4	8	6
" " for ships	13	...	1
Prismatic compasses	1	1	1
Magnetic "	...	6	6
Measuring tape, 100 feet	...	1	1
" " 50 feet	...	1	1
Sand glasses (3 minutes)	17	1	8
Sunshine recorder	1	...	1
Bull's-eye lantern	...	1	1
Sundials	...	5	4
Clocks	...	13	13
Bottles for wet bulb thermometers	...	119	7
Spirit level	1	...	1
Electrophorus	1	...	...
Filled tubes for marine K. P. barometers	10	...	2
" " observatory "	19	...	2
Chain for Casella's embossing anemograph	100 feet	...	...
Glass cylinder jars	2	...	2
Gauges for testing Symons's raingauges	...	6 pairs	5 pairs.

[illegible]

Return of Instruments issued to each Observatory in 1886-87—continued.

Province.	STATION.	HYGRO-METER.		Dry maximum thermometer.	MINI-MUM THERMO-METER.		RADIATION THERMO-METER.		Anemometer.	Wind vane.	Rain-gauge.	Measure glass.	Lens.	Clock.	Sand-glass.	Self-registering rain-gauge.	Sun-dial.	Ground surface thermometer.	Compass.	Stand for sun thermometer.	Pad for grass radiation thermometer.	Thermometer cage.	Bull's-eye lantern.	Aneroid.	Sunshine recorder.	Sling thermometer.	Common thermometer.	Glass cylinder jar.	Measuring tape.	Glass tube.	Water-bottles.	Spirit level.	REMARKS.		
		Barometer.	Dry.		Wet.	Dry.	Wet.	Solar.																										Grass.	
N.-W. PROVINCES AND OUDH.	Allahabad .	...	1	...	1	...	...	1	...	...	...	...	...	1	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Agra .	...	...	...	1	1	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Lucknow .	...	...	...	1	1	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Roorkee .	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Chakrata .	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ranikhet .	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bareilly .	...	1	1	1	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Meerut .	...	...	...	1	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ghazipur .	...	1	1	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Benares .	...	...	...	...	...	...	...	1	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Jhansi .	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Pithoragarh .	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
PUNJAB.	Mussooree .	1	1	1	1	1	1	1	1	1	1	1	...	...	...	...	...	...	...	1	1	1	...	...	...	...	...	...	...	...	2	...	...	...
	Lahore .	...	...	...	...	...	...	...	...	...	1	...	...	...	...	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mooltan .	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Dera Ismail Khan .	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Peshawar .	...	1	1	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Rawalpindi .	...	...	...	...	...	...	...	...	2	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Murree .	...	...	...	...	...	...	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sialkot .	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ludhiana .	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Chamba .	1	...	...	...	...	...	...	...	2	1	1	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...
	Simla .	...	...	1	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sirsa .	...	...	...	...	...	...	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
CENTRAL PROVINCES.	Nagpur .	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Jubbulpore .	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Pachmarhi .	...	...	...	...	...	1	...	1	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Hoshangabad .	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Khandwa .	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Seoni .	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Chanda .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sironcha .	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Raipur .	...	1	...	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sambalpur .	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	BERAR.	Akola	1	...	1
		Buldana	1	1	1
Chikalda .		...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Makhla .		...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Original furniture.

Return of Instruments issued to each Observatory in 1886-87—continued.

Province.	STATION.	HYGROMETER.		Dry maximum thermometer.	MINIMUM THERMOMETER.		RADIATION THERMOMETER.		Anemometer.	Wind vane.	Rain-gauge.	Measure glass.	Lens.	Clock.	Sand glass.	Self-registering rain-gauge.	Sundial.	Ground surface thermometer.	Compass.	Stand for sun thermometer.	Pad for grass radiation thermometer.	Thermometer cage.	Bull's-eye lantern.	Aneroid.	Sunshine recorder.	Sling thermometer.	Common thermometer.	Glass cylinder jar.	Measuring tape.	Glass tube.	Water-bottles.	Spirit level.	REMARKS.	
		Barometer.			Dry.	Wet.	Solar.	Grass.																										
CENTRAL INDIA AND RAJPUTANA.	Sutna . . .	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Nowgong . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Neemuch . . .	1	1	1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Indore . . .	...	...	...	...	1	2	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mount Abu . . .	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Pachbadra . . .	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ajmere . . .	...	...	...	1	2	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sambhar [l. . .	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bickaneer . . .	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BOMBAY.	Bombay Office . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Belgaum . . .	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Poona . . .	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Deesa . . .	...	...	...	...	1	2	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
	Jacobabad . . .	1	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Hyderabad . . .	...	...	...	...	...	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bhuj . . .	1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Rajkot . . .	...	1	...	1	...	...	2	1	...	...	...	...	...	...	...	...	...	...	1	1	1	...	...	...	...	...	...	...	...	...	...	...
	Sholapur . . .	...	...	...	...	...	2	1	...	...	...	1	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...
	Surat . . .	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Malegaon . . .	...	...	...	...	1	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ratnagiri . . .	1	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
	MADRAS, MYSORE, AND HYDERABAD.	Bellary . . .	1	1	1	1	1	...	1	...	1	1
		Trichinopoly	1
Gopalpore . . .		...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Masulipatam . . .		1	...	...	1	2	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Secunderabad . . .		...	...	...	1	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kurnool . . .		...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cuddapah . . .		...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Negapatam . . .		...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Madura . . .		1	...	...	1	...	...	1	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calicut . . .		...	...	...	...	1	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cochin . . .		...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mercara Post Office . . .		...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mercara (Civil Dispensary) . . .	1	1	1	1	1	1	1	1	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Rajahmundry . . .	...	...	...	...	...	...	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Original furniture.

Original furniture.

Return of Instruments issued to each Observatory in 1886-87—concluded.

Province.	STATION.	HY-GROME-TER.		Dry maximum thermometer.	MINI-MUM THER-MOME-TER.		RADI-A-TION THER-MOME-TER.		Anemometer.	Wind vane.	Rain-gauge.	Measure glass.	Lens.	Clock.	Sand-glass.	Self-registering rain-gauge.	Sun-dial.	Ground surface thermometer.	Compass.	Stand for sun thermometer.	Pad for grass radiation thermometer.	Thermometer cage.	Bull's-eye lantern.	Aneroid.	Sunshine recorder.	Sling thermometer.	Common thermometer.	Glass cylinder jar.	Measuring tape.	Glass tube.	Water-bottles.	Spirit level.	REMARKS.
		Barometer.	Dry.		Wet.	Dry.	Wet.	Solar.																										Grass.
EXTRA INDIAN.	Quetta	1	Original furniture.
	Bushire . . .	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Leh . . .	...	1	2	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Amini Divi . . .	...	...	...	1	...	...	...	2	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Baghdad . . .	1	1	1	1	1	1	...	1	1	1	1	...	1	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	2	...
	Thibet Scientific Mission . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...
	F. L. V. Hesperus . . .	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...
	Forest Department, Ajmere . . .	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Forest Department, Punjab . . .	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sitalha . . .	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Dacca (Civil Surgeon) . . .	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Barmer . . .	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mr. S. R. Elson . . .	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mr. H. F. Blanford . . .	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mr. J. Eliot . . .	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...
	Mr. W. L. Dallas . . .	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...
	Meteorological Office, India . . .	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mathematical Instrument Department . . .	3	1	26	

APPENDIX F.

List of Recipients of the Publications of the Meteorological Office.

Adelaide	Meteorological Observatory.
Agra	Editor of the <i>Delhi Gazette</i> .
Ajmere	Chief Commissioner of Ajmere.
Algeria	Director of the Meteorological Service of the École des Sciences d'Alger.
	Secretary to the Government, North-Western Provinces and Oudh.
	Department of Revenue and Agriculture, North-Western Provinces and Oudh.
Allahabad	Meteorological Reporter, North-Western Provinces and Oudh.
	Sanitary Commissioner, ditto ditto.
	Editor of the <i>Pioneer</i> .
Amraoti	Sanitary Commissioner for Berar.
Amsterdam	Royal Academy of Sciences.
Bangalore	Chief Commissioner, Mysore and Coorg.
	Inspector General of Forests, Mysore and Coorg.
Batavia, Java	Meteorological Observatory.
Berlin	Royal Prussian Meteorological Institute.
	Secretary to the Government of Bombay.
	Meteorological Reporter for Western India.
	Colaba Observatory.
	Sanitary Commissioner with the Government of Bombay.
Bombay	Bombay University.
	Asiatic Society of Bombay.
	Sassoon Mechanics' Institute.
	Geographical Society of Bombay.
	Editor of the <i>Bombay Gazette</i> .
	Ditto <i>Times of India</i> .
Brisbane, Queensland	Elphinstone College.
	Observatory.
Brussels	Royal Academy of Sciences.
	Observatoire Royal.
Bucharest, Roumania	Meteorological Institute.
Budapesth	Observatory.
	H.M. Secretary of State for India (through Revenue and Agricultural Department).
	Secretary to the Government of India, Revenue and Agricultural Department.
	Ditto ditto, Home Department.
	Ditto ditto, Public Works Department.
	Ditto ditto, Foreign Department.
	Ditto ditto, Department of Finance and Commerce.
	Ditto ditto, Military Department.
	Private Secretary to His Excellency the Viceroy.
	Secretary to the Government of Bengal, Revenue Department.
	Meteorological Reporter to the Government of Bengal.
	Surveyor-General of India.
Calcutta	Director, Geological Survey of India.
	Sanitary Commissioner with the Government of India.
	Ditto ditto ditto Bengal.
	Superintendent, Botanical Gardens, Calcutta.
	Inspector-General of Forests with the Government of India.
	Surgeon-General ditto ditto.
	Asiatic Society of Bengal.
	Indian Museum Library.
	Calcutta University.
	Presidency College.
	Public Library.
	Editor of the <i>Calcutta Review</i> .
	Ditto <i>Statesman and Friend of India</i> .

List of Recipients of the Publications of the Meteorological Office—continued.

Calcutta— <i>contd.</i>	{	Editor of the <i>Englishman</i> .
		Ditto <i>Indian Daily News</i> .
		Ditto <i>Hindu Patriot</i> .
		Ditto <i>Indian Agriculturist</i> .
		St. Xavier's College Observatory.
	{	The Alipore Observatory.
		Mint Master.
		Indian Association for the Cultivation of Science.
		University Library (through H. M.'s Secretary of State for India).
		Harvard University.
Cambridge	{	Astronomer Royal.
Cambridge, Massachusetts	{	Bureau für Meteorologie und Hydrographie.
Cape of Good Hope	{	Royal Meteorological Institute.
Carlsruhe, Baden, Germany	{	Royal Engineers' Library (through Revenue and Agricultural Department).
Chemnitz	{	Norske Meteorologiske Institut.
Chatham	{	Royal Observatory.
Christiania	{	Editor of the <i>Ceylon Times</i> .
Colombo	{	Ditto <i>Ceylon Observer</i> .
		Surveyor-General of Ceylon.
Copenhagen	{	Danske Meteorologiske Institut.
		Royal Danish Academy of Sciences.
Cordoba	{	Meteorological Office.
Darjeeling	{	National Academy of Science.
Dehra Dun	{	Conservator of Forests, Government of Bengal.
Dharwar	{	Editor of the <i>Indian Forester</i> .
		Superintendent, Great Trigonometrical Survey.
Dublin	{	Conservator of Forests, Bombay, Southern Division.
Dacca	{	Royal Dublin Society.
Edinburgh	{	Dacca College.
		Scottish Meteorological Society.
		Astronomer Royal for Scotland, Royal Observatory.
Ellichpore	{	Scottish Geographical Society (through H.M.'s Secretary of State for India).
Goa	{	Assistant Conservator of Forests, Molghat Division.
Greenwich	{	Royal Observatory.
Guatemala	{	Astronomer Royal, Royal Observatory.
Hamburgh	{	Observatorio Meteorologico del Institut Nacional de Guatemala.
Havana	{	Nord Deutsche Seewarte.
Hong-Kong	{	Deutsche Meteorologische Gessellschaft.
Indore	{	Real Collegio de Belen.
Iowa, U. S.	{	Observatory.
Jeypore	{	Agent to the Governor General for Central India in charge of the Residency.
Jubbulpore	{	Iowa Weather Service.
Katmandu	{	Maharajah's Observatory.
Khandwa	{	Civil Surgeon of Jubbulpore.
Kitzingen, Bavaria	{	Resident at Nepal.
Kurrachee	{	Civil Surgeon of Nimar.
Lahore	{	Dr. Emil Von Schlagintweit.
		Conservator of Forests, Bombay, Sind Division.
		Secretary to the Government of the Punjab.
		Meteorological Reporter ditto ditto.
Leeds	{	Sanitary Commissioner ditto ditto.
		Conservator of Forests ditto ditto.
Leipzig	{	Yorkshire College (through H.M.'s Secretary of State for India).
Lisbon	{	Geographical Society.
		Observatoire de Infante d'Luiz.
		Academy of Sciences.
London	{	Meteorological Council.
		Royal Society.
		Royal Asiatic Society (through H.M.'s Secretary of State for India).
		Northbrook India Club (through H.M.'s Secretary of State for India).
		Society of Arts.
		Institution of Civil Engineers.
	{	Royal School of Mines.

List of Recipients of the Publications of the Meteorological Office—continued.

	Royal Meteorological Society.
	Admiralty Library.
	United Service Museum.
	British Museum (through H.M.'s Secretary of State for India).
	Athenæum Club.
London—contd.	Editor of the <i>Philosophical Magazine</i> .
	Ditto <i>Athenæum</i> .
	Ditto <i>Nature</i> .
	Ditto <i>Symons's Monthly Meteorological Magazine</i> .
	Ditto <i>Westminster Review</i> .
	Ditto <i>Quarterly Review</i> .
	Secretary to the Government of Madras.
	Ditto ditto, Public Works Department.
	Meteorological Reporter to the Government of Madras.
	Government Astronomer, Madras.
	Sanitary Commissioner, Government of Madras.
	Madras University.
	Editor of the <i>Madras Times</i> .
Madras.	Ditto <i>Madras Mail</i> .
	Ditto <i>Christian College Magazine</i> .
	Government Central Museum.
	Assistant Director of Agriculture, Government of Madras.
	Surgeon-General, British Medical Department.
	Ditto, Indian Medical Department.
	Master Attendant of Madras.
	Conservator of Forests, Northern Circle.
Madrid	Royal Observatory.
Magdeburg	Observatory of the Magdeburg Zeitung.
Manchester	Literary and Philosophical Society.
Manila	Meteorological Observatory.
Mauritius	Meteorological Society.
	Observatory.
Melbourne, Victoria	University Library.
	Public Library.
Mexico	Central Meteorological Observatory.
Milan	Royal Astronomical Observatory.
	Royal Observatory.
Munich	Royal Bavarian Academy of Sciences.
	Geographical Society.
	Royal Bavarian Meteorological Central Station.
	Chief Commissioner, Central Provinces.
Nagpur	Sanitary Commissioner, ditto.
	Inspector General of Education, Central Provinces.
	Meteorological Observatory.
	Conservator of Forests, Central Provinces.
Naini Tal	Ditto ditto, North-Western Provinces and Oudh.
New Haven, Connecticut	Connecticut Academy of Arts and Science.
	Editors of the <i>American Journal of Science</i> .
New York, U. S.	Central Park Observatory.
Nowgong, Rajshahye	Sub-Divisional Officer.
Ootacamund	Conservator of Forests, Government of Madras.
	Editor of the <i>South of India Observer</i> .
	Radcliffe Library.
Oxford	Radcliffe Observatory.
	Observatoire Physique Central de Montsouris.
	Editor of <i>La Nature</i> .
Paris	Physical Observatory, Meudon.
	Bureau Central Météorologique.
	Meteorological Society of France.
Perpignan, France	Observatoire Météorologique et Magnétique.
Perth, W. Australia	Surveyor-General.
Pesaro, Italy	Royal Observatory.
Philadelphia	Franklin Institute.

List of Recipients of the Publications of the Meteorological Office—concluded.

Poona	Conservator of Forests, Bombay, Northern Division.
Prag, Bohemia	Observatory.
Raipur	Civil Surgeon of Raipur.
	Chief Commissioner, Burma.
Rangoon	Sanitary Commissioner, ditto.
	Conservator of Forests, ditto.
	Editor of the <i>Rangoon Times</i> .
Rome	Meteorological Office (Ministry of Agriculture).
Rio di Janeiro	Imperial Observatory.
Saharunpore	Superintendent, Botanic Gardens.
Santiago	Observatorio Nacional.
Secunderabad	Secretary to the Resident at Hyderabad.
Shillong	Chief Commissioner of Assam.
	Conservator of Forests, Assam.
Simla	Assistant Quarter Master General, Intelligence Branch.
Singapore	Principal Civil Medical Officer, Straits Settlements.
Stockholm	Nautisk Meteorologiska Byran.
	Observatoire Physique Central.
St. Petersburg	Geographical Society of Russia.
	Prof. H. Wild, Central Physical Observatory.
Strasburg	Imperial University Library.
Stonyhurst	Stonyhurst College Observatory.
Sydney	Observatory.
	University Library.
Syracuse, Sicily	Royal Meteorological Observatory.
Tasmania	Royal Society.
Tiflis, Russia	Physical Observatory.
	Imperial Mining Office.
Tokei, Japan	Imperial Meteorological Observatory.
Toronto, Canada	Magnetical and Meteorological Observatory.
Turin	Royal Astronomical Observatory.
	Meteorological Society of Italy.
Upsala	Meteorological Observatory.
Utrecht	Royal Netherlands Meteorological Institute.
	K.K. Central-Anstalt für Meteorologie und Erdmagnetismus.
	K.K. Geologische Reichsanstalt.
Vienna	Imperial Academy of Sciences.
	Dr. J. Hann.
Vizigapatam	A. V. Nursingrow, Esquire.
	Chief Signal Officer, United States Army.
	Smithsonian Institution.
Washington, U. S.	Naval Observatory.
	Hydrographic Office.
	Professor Cleveland Abbe, Signal Office.
	United States Geological Survey.
Wellington, New Zealand	Observatory.
Woolwich	Royal Artillery Library.
Zi-ka-wei, Shanghai	Magnetical and Meteorological Observatory.
Zurich	Central Meteorological Institute.

APPENDIX G.

Presentations to the Library from the 1st April 1886 to the 31st March 1887.

Place.	Donors.	Title of Work.
ALGERIA	Meteorological Service	Bulletin Météorologique du Gouvernement général de l'Algérie, 16th February 1886 to 16th February 1887. Bulletin Mensuel, July 1885 to July 1886. Statistique de la Grêle tombée en Algérie pendant les dix dernières années de 1876 à 1885.
ALLAHABAD	Meteorological Office	Administration Report of the Meteorological Reporter to the Gov- ernment of the North-Western Provinces and Oudh for the year 1885-86. Brief Sketch of the Meteorology of the North-Western Provinces, Oudh and Eastern Rajputana for the year 1885.
ALLEGHANY	Professor Langley	Hitherto Unrecognised Wave-lengths.
AMSTERDAM	Royal Academy of Sciences	Jaarboek, 1884. Verslagen en Mededeelingen der Koninklijke Akademie van Wetenschappen Afd Natuurkunde, Derde Reeks, Deel I.
BATAVIA	Magnetical and Meteorological Observatory	Observations made at the Magnetical and Meteorological Obser- vatory in Batavia, Vol. VI, Supplement; Vol. VII, Part I. Rainfall in the East Indian Archipelago for 1885.
BERLIN	Austrian and German Meteorological Society. Koniglich Preussischen Meteorologischen Institut.	Meteorologische Zeitschrift, March 1886 to February 1887. Ergebnisse der Meteorologischen Beobachtungen im Jahre 1885.
BERNE	Dept. de l'intérieur de la Confédération Suisse	Grâphische Darstellung der hydrometrischen Beobachtungen über das Rhine, Aare, Rhone, Reuss, Limmat and Tessin Gebiet, January to June 1886.
BOMBAY	Government of Bombay Meteorological Office	Bombay Gazetteer, Vols. XVII, XIX, XX, XXIV and XXV. Twenty-second Annual Report of the Sanitary Commissioner for the Government of Bombay for 1885, with appendices. Brief Sketch of the Meteorology of the Bombay Presidency in 1885-86.
BONN	Dr. D. Brandis	Ein neuer Thermograph von Dr. W. Kochs.
BRUSSELS	A. Lancaster	Liste générale des observatoires et des Astronomes, des Sociétés et des revues Astronomiques. Climat de la Belgique en 1886.
BUCHAREST	Institutul Meteorological Romaniei	Buletinul Ministerului Agriculturii, industriei, comerului si do- meânilor, Anul I, 1885, Nos. 2-12. Annales de l'Institut Météorologique de Roumanie pour l'année 1885, Tome I.
CALCUTTA	Comptroller and Auditor General.	Civil Estimates for 1886-87. Civil Account Code, Vol. I.

Presentations to the Library from the 1st April 1886 to the 31st March 1887—continued.

Place.	Donors.	Title of Work.
CALCUTTA —contd.	Director General of Post Offices in India.	Indian Postal Guide, April and November 1886.
	Geological Survey of India .	Records of the Geological Survey of India, Vol. XIX, Parts II to IV; Vol. XX, Part I.
	Government of Bengal	Returns of the rail-borne traffic of Bengal during the quarters ending the 31st December 1885 and 31st March, 30th June and 30th September 1886.
		Report on the external trade of Bengal with Nepal, Sikkim, and Bhutan for the year 1885-86.
		Report on the rail-borne traffic of Bengal during the year 1885-86.
		Report on the river-borne traffic of the Lower Provinces of Bengal, and on the Inland trade of Calcutta, and on the trade of Chittagong and the Orissa Ports, with notes on road traffic, for 1885-86.
		International Meteorological Observations from 1st January to 31st December 1883. Published by the Chief Signal Office, U. S. A.
	Government of India, Home Department.	Bulletin of International Meteorology for January to December 1883. Published by the Chief Signal Office, U.S.A.
		Professional papers of the Signal Service, U.S.A., No. 15.
		Imported elm leaf beetle: its habits and natural history, and means of counteracting its injuries. Published by the U. S. Department of Agriculture.
		Proceedings of the United States National Museum, Volume VII, 1884.
		Report of the Meteorological Council to the Royal Society for the year ending 31st March 1885.
	Government of India, Re- venue and Agricultural Department.	Imperial Gazetteer of India, 2nd Edition, Volumes I to XI.
		Administration Report upon the Madras Observatory for the year 1885.
		Report on the condition and proceedings of the Government Observatory, Colaba, for 27th June to 29th December 1868, 30th December 1868 to 30th June 1869, 1st July 1869 to 31st December 1870; and the years ending 30th June 1877, 30th June 1878, 30th June 1879, 30th June 1885, and 30th June 1886.
		List of Civil Officers holding gazetted appointments under the Government of India in the Home, Legislative, Foreign, and Revenue and Agricultural Departments, corrected to 1st July 1886.
		Papers relating to the False Point cyclone of 22nd September 1885.
		Statistical Atlas of India prepared for the Colonial and Indian Exhibition, 1886.
		Some snow measurements at Kailang and Lahoul.
	Henry F. Blanford, Esq., F.R.S.	Report on the registration of Ozone in the Bombay Presidency for the years 1863-64 and 1864-65.
		Inundations of the Delta of the Mississippi and Ohio rivers.
	Meteorological Office, Bengal	Administration Report of the Meteorological Reporter to the Government of Bengal for 1885-86.
	Surveyor General of India .	General Report on the operations of the Survey of India Department during 1884-85.
		Account of the operations of the Great Trigonometrical Survey of India, Vol IVA.

Presentations to the Library from the 1st April 1886 to the 31st March 1887—continued.

Place.	Donors.	Title of Work.
CARLSRUHE	Bureau für Meteorologie und Hydrographie, Baden.	Jahres-Bericht für das Jahr 1885.
CHEMNITZ	Royal Meteorological Institute.	Jahrbuch des Königl. Sächs, meteorologischen institutes, 1885. Resultate der meteorologischen Beobachtungen der Sternwarte Leipzig im Jahre, 1884 and 1885.
CHRISTIANIA	Norwegian Meteorological Institute.	Jahrbuch im 1885.
COLOMBO	Surveyor General of Ceylon	Administration Report, 1885, Part II, Scientific.
COPENHAGEN	Institut Météorologique Danois.	Bulletin Météorologique du Nord, February 1886 to January 1887, Annuaire météorologique pour l'année 1882, parts I, II, III; 1883, parts I, II, III; 1884, parts I and III.
	Royal Academy of Sciences.	Oversigt, No. 3 of 1885, and Nos. 1, 2 of 1886.
CORDOBA	National Academy of Sciences.	Boletin de la Academia Nacional de Ciencias en Cordoba (Republica Argentina) Tome III, IV, V, and VIII, Entrega 2, 3 and 4a. Actas de la Academia Nacional de Ciencias en Cordoba, Tome III, Entrega 2, Tome IV, Entrega 1.
DEHRA DUN	Director, Forest School	Report on the course of instruction at the Forest School, Dehra Dun, during 1885.
	Editor, Indian Forester	Indian Forester, April 1886 to March 1887.
	Trigonometrical Branch, Survey of India.	Synopsis of the results of the operations of the Great Trigonometrical Survey of India, Vol. XIII A. Spirit-levelled heights, No. 1 Madras Presidency, Seasons 1869, 1885, and Nos. 2 and 3 Bombay Presidency and Nizam's dominions, seasons 1877-80 (revised edition).
DORPAT	K. Weihrauch.	Ueber Pendelbewegung bei ablenkenden Kräften, nebst Anwendung auf das Foucault'sche Pendel. Ueber die Dynamischen centrale des Rotations ellipsoids, mit Amdendung auf die erde.
	Meteorological Observatory.	Bericht über die Ergebnisse der Beobachtungen an den Regensstationen für das Jahr 1885.
DUBLIN	Royal Dublin Society	Scientific Proceedings, Vol. IV, New Series, Parts 7 to 9; Vol. V, New Series, Parts 1 and 2. Scientific Transactions, Series II, Vol. III, Nos. 7 to 9.
EDINBURGH	Pyazzi Smyth, F.R.S.E.	Micrometrical measures of gaseous spectra under high dispersion.
	Royal Observatory	Edinburgh Astronomical Observations, Vol. XV, 1877-86.
	Scottish Meteorological Society.	Journal, 3rd Series, No. III.
GOA	Royal Observatory	Observações meteorologicas de Goa, 1st Semestre de Anno de 1882.
GREENWICH	Magnetical and Meteorological Observatory.	Greenwich Magnetical and Meteorological Observations, 1884.
HAMBURG	Deutsche Seewarte	Meteorologische Beobachtungen in Deutschland für 1883 and 1884. Wetterbericht 1st February 1886 to 28th February 1887.

Presentations to the Library from the 1st April 1886 to the 31st March 1887—continued.

Place.	Donors.	Title of Work.
HAMBURG— <i>contd.</i>	Deutschen Seewarte— <i>contd.</i>	<p>Monatliche Übersicht der Witterung, May 1885 to December 1885, and the year 1885.</p> <p>Aus dem Archiv der Deutschen Seewarte, 1884.</p>
HAVANNA	Real Colegio de Belen	<p>Observaciones Magnéticas y Meteorológicas, July to September 1885.</p> <p>Annual Report of the Hongkong Observatory for 1885.</p> <p>Weather Report for December 1885 to December 1886.</p> <p>Practical use of the meteorological signals.</p> <p>Five day means of the principal meteorological elements for 1885.</p> <p>Annual Weather Report of the Director of the Hongkong Observatory, 1885.</p>
HONGKONG	Observatory	<p>Results of barometric observations made during 25 years in Hongkong.</p> <p>Report on information issued daily in 1885 concerning Typhoons.</p> <p>Observations and Researches made at the Hongkong Observatory in the year 1885.</p> <p>One year's observations of thermometers exposed in Stevenson's screen.</p> <p>Report on the Typhoons of 1884 and 1885.</p> <p>List of Meteorological stations in the far East in communication with the Hongkong Observatory in 1885.</p>
IOWA	Iowa Weather Service	Report of the Iowa Weather Service, May to August 1881, and January to December 1883.
JEYPORE	Superintendent, Jeypore, Medical and Meteorological Institutions	Annual Report of the Jeypore Medical and Meteorological Institutions for 1885.
LAHORE	Government of the Punjab	Report on the Meteorology of the Punjab in 1885-86.
	Meteorological Office	Summary of Meteorological conditions prevailing over the Punjab during July 1886 to February 1887.
	Dr. Henry B. Baker	Notes on the relations of rainfall and water-supply to cholera.
	State Board of Agriculture	<p>Twenty-third Annual Report of the State Board of Agriculture of the State of Michigan.</p> <p>Report of the State Board of Health of the State of Michigan for 1879 to 1885.</p>
LANSING (Michigan)	Michigan State Board of Health	<p>Proceedings and addresses at the sanitary convention for 1880 to 1885.</p> <p>Principal meteorological conditions in Michigan in 1877 and 1879 to 1883.</p> <p>Purification of water by freezing.</p> <p>Some meteorological aspects of ventilation.</p> <p>Overflowed lands on the Maple river.</p>

Presentations to the Library from the 1st April 1886 to the 31st March 1887—continued.

Place.	Donors.	Title of Work.
LANSING (Michigan)— <i>contd.</i>	Michigan State Board of Health— <i>contd.</i>	Effects on public health of overflowed lands adjacent to Maple river.
		Prevention of Typhoid fever.
		Prevention and restriction of Cholera.
		Prevention of the introduction of communicable diseases.
		Works of health affairs and of local boards of health in Michigan, including duties under laws amended and passed in 1883.
		Restriction and prevention of Diphtheria.
		Restriction and prevention of Scarlet fever.
		Restriction and prevention of Small-pox.
		Typhoid fever and low water in wells.
		Atmospheric ozone and the best methods for its observation.
		Ozone in nature, its relations, sources, and influences.
		Causation of intermittent fever.
		Reclaiming of drowned lands.
		Study of the climate and topography of the lower peninsula of Michigan.
		Climate and health in Michigan.
	G. J. Symons, Esquire	Symons's Monthly Meteorological Magazine, March 1886 to February 1887.
		Report of the Meteorological Council to the Royal Society for the year ending March 1885.
		Meteorological observations at stations of the second order for the years 1881 and 1882.
		Daily Weather Report, 1st July to 31st December 1885 and 1st January to 30th June 1886.
		Weekly Weather Report, Vol. II, Nos. 47 to 52, and Vol. III, Nos. 1 to 52.
		Monthly Weather Report, September 1885 to August 1886.
LONDON	Meteorological Office	Hourly Readings, Parts III and IV of 1883 and Parts I and II of 1884.
		Quarterly Weather Report, Part I of 1878.
		Observations of the International Polar Expedition for 1882-83.
		Bulletin International du Bureau Central Météorologique de France, for 1885 and 1886.
		The Meteorological Record, Vol. V, Nos. 19-22.
		Quarterly Journal, Vol XII, Nos. 57 to 60.
		Report on the temperature and rainfall of the Croydon district, 1881-85.
		Catalogue of Scientific Instruments.
		Working of the Harmonic Analyser at the Meteorological Office, London.
	Meteorological Society	
	Negretti and Zambra	
	R. H. Scott, Esquire	

Presentations to the Library from the 1st April 1886 to the 31st March 1887—continued.

Place.	Donors.	Title of Work.
LONDON— <i>contd.</i>	Royal Asiatic Society . . .	Journal, Vol. XVIII, Parts II to IV, and Vol. XIX, Part I.
	Royal Society . . .	Proceedings Nos. 240 to 248.
	Society of Arts . . .	Journal Nos. 1738 to 1790.
MADRAS .	Metcorological Office .	Administration Report of the Meteorological Reporter to the Government of Madras for 1885-86.
MAGDEBURG .	Magdeburgischen Zeitung	Jahrbuch der Meteorologischen Beobachtungen für 1884.
MARIASCHEN (Bohemia).	Dr. Carl Braun, S.J. .	Berichte von dem Erzbischöflich-Hylandschen observatorium zu kalocsa in Ungarn über die daselbst in den ersten fünf Jahren ausgeführten Arbeiten.
MAURITIUS .	Royal Alfred Observatory .	Mauritius Meteorological Results for 1881, 1884, and 1885.
MELBOURNE .	Observatory . . .	Monthly record of results of observations in meteorology, terrestrial magnetism, &c., taken at the Melbourne Observatory for November 1885 to September 1886.
MEXICO .	Central Meteorological Observatory.	Boletin del Ministerio de Fomento de la Republica Mexicana, Tomo X, Nos. 114 to 146.
MILAN .	R. Osservatorio Astronomico di Brera.	Osservazioni Meteorologiche eseguite nell' Anno 1886.
	Geographical Society .	Jahresbericht für 1885.
MUNICH .	Meteororologischen Central station.	Beobachtungen der Meteorologischen stationen im Königreich Bayern 1879 to 1885 und 1886 hefte i & iii. Monatliche Uebersichten über die Witterungsverhältnisse im Königreich Bayern 1879-1885, and January to May and September to December 1886. Meteorologische Ephemeriden, 1781 to 1789.
		Returns of Railway-borne Traffic for the quarters ending 31st December 1885, and 31st March, 30th June and 30th September 1886.
		Report on Wheat and Linseed Crops of 1886.
NAGPUR .	Chief Commissioner, Central Provinces.	Review of the Reports on the Estates under Government management in the Central Provinces during the year ending 30th September 1885. Report on the Nagpur Experimental Farm in the Central Provinces for the year 1885-86. Cotton Forecast of 1886. Report on the Railway-borne traffic of the Central Provinces for the year 1885-86. Forecast of Wheat and Linseed Crops of 1887.
NEW YORK .	Meteorological Observatory	Abstract of Registers from self-recording instruments, December 1885 to December 1886. Annual Report for 1885. Memoir of John William Draper.
OXFORD .	Radcliffe Observatory .	Results of Meteorological Observations made at the Radcliffe Observatory, Oxford, in the year 1883.

Presentations to the Library from the 1st April 1886 to the 31st March 1887—continued.

Place.	Donors.	Title of Work.
PARIS . . .	{ Bureau Central Météorologique de France.	Bulletin International, Vol. XXX, Nos. 57 to 365; Vol. XXXI, Nos. 1-62.
		Annales du Bureau Central Météorologique de France, année 1882, Tome II; année 1883, Tomes I, III, IV; année 1884, Tomes I, III & IV.
		Bulletin Mensuel, February, October, and December 1886.
		Rapport du Comité Météorologique International Réunion de Paris, 1885.
PERPIGNAN . . .	{ Société Météorologique de France.	Annuaire, May, June, November, and December 1885; February to October 1886.
PHILADELPHIA . . .	{ Meteorological and Magnetical Observatory.	Bulletin Météorologique du Département des Pyrénées-Orientales Années 1875 and 1877 to 1884.
	Franklin Institute . . .	Journal, March 1886 to February 1887.
POLA . . .	{ K. K. Hydrographisches Amte.	Meteorologische und Magnetische Beobachtungen, October 1885; February to September, and December 1886; January 1887.
		Jahresbericht der Meteorologischen und magnetischen Beobachtungen, 1886.
PRAGUE . . .	{ K. K. Sternwarte . . .	Magnetische und Meteorologische Beobachtungen im Jahre, 1885.
RICHMOND . . .	{ Kew Observatory . . .	Report of the Kew Committee for the year ending 31st October 1886.
RIO DE JANEIRO . . .	{ Imperial Observatory . . .	Revista do Observatorio, January 1886 to January 1887.
RIPOSTO (ITALY) {	{ Osservatorio Meteorologico del R. Istituto Nautico . . .	Bollettino Mensile, de January 1886 à January 1887.
		Sulla Tromba terrestre del 7th October 1884.
ROME . . .	{ Meteorological Office . . .	Annali dell'ufficio central di meteorologia, Vols. II to V.
SANTIAGO . . .	{ National Astronomical Observatory . . .	Meteorological Observations, 1882 to 1884.
SIMLA . . .	{ Inspector-General of Forests with the Government of India.	Note on an Inspection of the Forests in the Central Provinces, November 1885 to February 1886.
		Review of the Forest Administration in British India for 1884-85.
		Note on an Inspection of the Forests in Oudh in March and April 1886.
SINGAPORE . . .	{ Colonial Surgeon . . .	Annual Report of the Meteorological Observations in the Straits Settlements for the years 1885 and 1886.
ST. PETERSBURGH {	{ Dr. A. Woeikof . . .	Influence of Forests upon Climate.
		Repertorium fur Meteorologie, Band IX.
	Central Physical Observatory {	Annalen des Physicalischen Central Observatoriums, Jahrg 1884.
STONYHURST . . .	{ Stonyhurst College Observatory	Results of Meteorological and Magnetical Observations, 1885.
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		Annual address delivered to the Royal Society of New South Wales on the 6th May 1885.
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Presentations to the Library from the 1st April 1886 to the 31st March 1887—continued.

Place.	Donors.	Title of Work.
TASMANIA . .	Royal Society . . . {	Papers and Proceedings of the Royal Society of Tasmania for 1885.
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TOKEO . .	{ Imperial Meteorological Ob- servatory. }	Monthly and yearly means, extremes, and sums for the years 1883-1884 and 1885.
TORONTO . .	Meteorological Office . .	Monthly Weather Review, February to November 1886.
TRIESTE . .	{ Marine Observatorium der K. K. Handels und Nautischen Akademie . . . }	Rapporto Annuale dell' Osservatorio Marittimo di Trieste per l'anno 1884. Bollettino dell' Osservatorio, Anno XX (1885). Effemeridi del Sole, della Luna e dei principali Pianeti calcolate, per Torino in tempo medio civile di Roma, per l'Anno 1887. Breve notizia delle Osservazioni astronomiche e geodetiche del guite nel 1885, per iniziativa ed a spese della Commissione del Grado. Nota prima sulla mira meridiana dell' Osservatorio di Torino a Cavoretto, ecc. Nota seconda id id id Nota terza id id id Nota prima intorus all' equatoriale con refrattore Merz di 30 centimetri, di apertura e metri $4\frac{1}{2}$ di distanza focale. Nota seconda id id id Nota terza id id id Nota quarta id id id Nota sulle Osservazioni delle Comete Fabry, Barnard e Brooks (a 1886) fatte all' equatoriale di Merz. Bollettino Mensuale, Serie II, Vol. V, Nos. 11 and 12; Vol. VI, Nos. 1 to 9 and 11 and 12. Bollettino Decadico Anno XIV, Nos. 6 to 12. Le Osservazioni Meteorologiche seguite da Giacomo Bove nel Territorio Argentino delle missioni ed il clima del Parma. Annuario Meteorologico Italiana Anno I, 1886; Anno II, 1887.
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UPSALA . .	{ Knut Angström . . . }	Sur une nouvelle méthode de faire des mesures absolues de la chaleur rayonnante, ainsi qu'un instrument pour enregistrer la radiation solaire.
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Presentations to the Library from the 1st April 1886 to the 31st March 1887—continued.

Place.	Donors.	Title of Work.
VIENNA	K. K. Geologische Reichsanstalt.	<p>Verhandlungen, Nos. 2 to 18 of 1886; No. 1 of 1887.</p> <p>Anzeiger Nos. 22 to 28 of 1883; Nos. 1 to 28 of 1884; Nos. 1 to 23 of 1885.</p> <p><i>F. Zehden.</i>—Methode der directen Rechnung einer wahren Mond-distanz aus einer beobachteten.</p> <p>Rationelle Verwerthung nicht steuerbarer Winkelunterschiede bei Kursbestimmungen zur See.</p> <p><i>Hann.</i>—Die Temperaturverhältnisse der österreichischen Alpen-länder, Theils I und II.</p> <p><i>Eduard Freih. v. Haerdtl.</i>—Bahnbestimmung des Planeten "Ad-ria," Theil III.</p> <p><i>Norbert Herz.</i>—Bahnbestimmung des Planeten, (232) Russia.</p> <p>Entwicklung der störenden Kräfte nach Vielfachen die mittleren Anomalien in independenter Form. Bahnbestimmung des Planeten (242) Kriemhild.</p> <p><i>Paul Czermak und Richard Hiecke.</i>—Pendelversuche.</p> <p><i>Eduard Glaser.</i>—Die Sternkunde der süd-arabischen Kabylen.</p> <p><i>J. Hepperger.</i>—Über die Verschiebung des Vereinigungspunktes der Strahlen beim Durchgange eines Strahlenbüschels monochromatischen Lichtes durch ein Prisma mit gerader Durchsicht.</p> <p>Über Krümmungsvermögen und Dispersion von Prismen.</p> <p><i>Gaber.</i>—Über die Helligkeits und Farbenempfindlichkeit einiger Meerthiere.</p>
	Royal Academy of Science	<p><i>Liznar.</i>—Über den täglichen und Jährlichen Gang sowie über die Störungsperioden der magnetischen Declination Zu Wien.</p> <p><i>Sigmund v. Wroblewski.</i>—Über den Gebrauch des siedenden Sauer-stoffs, Stickstoffs, Kohlenoxyds, sowie der atmosphärischen Luft als Kältemittel.</p> <p><i>Ignaz Klemencic.</i>—Experimentaluntersuchung über die Dielektri-citätsconstante einiger Gase und Dämpfe.</p> <p><i>Eduard Mahler.</i>—Astronomische Untersuchung über die in der Bibel erwähnte ägyptische Finsterniss.</p> <p><i>Viktor v. Lang.</i>—Messung der elektromotorischen Kraft des elek-trischen Lichtbogens.</p> <p><i>Eduard Aulinger.</i>—Über das Verhältniss der Weber'schen Theo-rie der Elektrodynamik Zu dem von Hertzaufgestellten Princip der Einheit der elektrischen Kräfte.</p> <p><i>Julius Oppert.</i>—Die astronomischen Angaben der assyrischen Keilinschriften.</p> <p><i>J. M. Eder.</i>—Spectrographische Untersuchung von Normal-Licht-quellen und die Brauchbarkeit der letzteren zu photochemischen Messungen der Lichtempfindlichkeit.</p> <p><i>Alois Handl.</i>—Über ein neues Hydromensimeter.</p> <p><i>E. Mach und J. Arbes.</i>—Einige Versuche über totale Reflexion und anomale Dispersion.</p> <p><i>Johann Unterwiesing.</i>—Beiträge zur Erklärung der Kosmisch-ter-restrischen Erscheinungen.</p>

Presentations to the Library from the 1st April 1886 to the 31st March 1887—concluded.

Place.	Donors.	Title of Work.
VIENNA— <i>contd.</i>	Royal Academy of Science — <i>contd.</i>	<i>Rudolf Spitaler.</i> —Die Warmevertheilung auf der Erdoberfläche. Die Internationale Polarforschung, 1882-83. Die österreichische Polarstation, January to May, Band I; Band II, Abtheilung II; Band III.
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	Chief Signal Office	Daily Bulletin of the Signal Service, October and November 1872, and November 1877. International Meteorological Observations, 1st January to 30th June 1884. Report of the Chief Signal Office, War Department, for 1884. Tridaily Charts, January 6th to 10th, 1886.
WASHINGTON	Hydrographic Office	Pilot Chart of the North Atlantic Ocean, August to October and December 1886, and January and February 1887.
	Philosophical Society	Bulletin of the Philosophical Society of Washington, Vols. VII to IX.
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- Comptes Rendus de l'Academie des Sciences, Vol. XCVIII, No. 1, Vol. CII, Nos. 9 to 26; Vol. CIII, Nos. 1 to 26 Vol. CIV, Nos. 1 to 9; Tables for Tomes C, CI, CII.
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- Inorganic Chemistry—Frankland and Japp.
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REPORT
ON
THE ADMINISTRATION
OF THE
METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA
IN
1887-88.

PART I.—GENERAL.

THE present report is divided into two parts. The first deals with the more important general and administrative questions that have arisen and been under discussion during the year. The second part describes briefly the actual working of the department, and the condition of the observatories, and includes extracts from the Administration Reports of the Local Reporters.

The permanent head of the department, Mr. H. F. Blanford, went on furlough on the 1st May 1887. During the remainder of the year I acted as Meteorological Reporter to the Government of India, and Mr. Pedler officiated for me as Meteorological Reporter to the Government of Bengal.

Very shortly after I took over charge of the department, I was asked to submit proposals or suggestions for the more efficient and economical working of the department, and for extending its practical value and usefulness as a centre for collecting and disseminating meteorological statistics and information without sacrificing or impairing the scientific portion of the work of the department to which it had hitherto, in the opinion of Government, been too exclusively confined. These were submitted in the form of a Note to Government together with a memorandum from Mr. Blanford approving in part of the changes and additions suggested in my Note. For various reasons the consideration of the whole scheme of proposals has been deferred for some months. It was, however, found desirable to introduce during the present year 1888 a portion of the changes contemplated in my scheme, and I therefore submitted, in November 1887, a partial scheme, which the Government of India were pleased to approve, and to sanction as a tentative measure, preliminary to the consideration and final adoption of the permanent changes necessary to effect the improvements desired by Government.

The most important of these were:—

- (a) The discontinuance of the solar and terrestrial radiation observations, except at a few selected stations.

- (b) The adoption of 8 A.M. as the hour of observation for the observations embodied in the weather telegrams transmitted daily to Simla, Calcutta and Bombay.
- (c) The tabulation of all the observations hitherto recorded in a form admitting of easy reference, and the calculation of daily averages of air pressure, maximum and minimum temperatures, aqueous vapour pressure, cloud and rainfall.
- (d) The extension and improvement of the methods of collecting rainfall data for the information of the Government of India, and the adoption of a uniform system of rainfall registration throughout India.

The reasons for, and objects of, these changes are given in the following paragraphs.

(A). ABOLITION OF THE SOLAR RADIATION AND TERRESTRIAL RADIATION OBSERVATIONS.—These observations are open to various objections. The instruments by means of which they are taken are very fragile, and have to be exposed in the open, and hence are peculiarly liable to breakage by hail, wind, &c., and are always very tempting objects to persons with destructive tendencies. Hence the observations were frequently interrupted, and the cost of renewing the broken instruments was found to be considerable.

The instruments are also very unsatisfactory and unsuited for exact measurement. Two instruments, apparently identical in construction, will frequently give different readings under the same circumstances. They also become much less sensitive with use, and the rate at which they lose sensitiveness varies very differently in different instruments. Examples from the observations of recent years, illustrating this defect, are given in the Annual Report of the Meteorology of India for the year 1887, and it is hence unnecessary to quote them here. Consequently, these thermometers are utterly useless for exact measurement, unless they are frequently compared with an invariable standard, and this was quite impossible for the hundred and twenty instruments hitherto in use over the whole of India. Their errors and rate of change at any time could not be ascertained, and hence they stood condemned as unreliable measuring instruments.

Finally, if the observations are to be utilized for the objects for which they profess to be taken, *viz.*, the measurement of the intensity of the solar radiation at and near the earth's surface, and of changes in it, a number of subsidiary observations would be necessary in order to eliminate disturbing actions, *e.g.*, the variable amount of radiation from the earth's surface near the instrument, &c. As this is never done, the observations themselves are probably of little real use for the enquiry for which they are assumed to be taken.

It might perhaps be urged that, if a very large number of observations were taken, and average results were obtained, the errors due to local actions and imperfections of the instruments would mutually compensate and the results would be approximately correct and accurate. I have examined several years' observations, and my own opinion is that the solar radiation observations hitherto obtained are unsatisfactory and of little value even from this standpoint, and that, if any useful results are to be obtained, it can only be by having the observations taken at a few selected stations, and under different conditions from those hitherto in force at the majority of stations in India. I consulted Messrs. Dallas, Hill and Pedler, and all agreed with me that it was desirable to discontinue these observa-

tions except at a few selected stations, and Mr. Blanford in his memo. concurred in the proposal. Hence these observations were discontinued with the sanction of Government from the 1st of January 1888, at all except the following stations :—

Aden.	{ Poona.
{ Lahore.	{ Bombay.
{ Simla.	Madras.
{ Leh.	Vizagapatam.
{ Rawalpindi.	{ Coimbatore.
{ Murree.	{ Wellington.
{ Nagpur.	{ Lucknow.
{ Pachmarhi.	{ Ranikhet.
Rangoon.	{ Roorkee.
{ Calcutta (Alipore).	{ Dehra.
{ Dhubri.	{ Chakrata.
{ Darjeeling.	Allahabad.
Silchar.	Jeypore.
{ Deesa.	
{ Mount Abu.	

(B). THE ADOPTION OF 8 A.M. AS THE HOUR FOR RECORDING OBSERVATIONS FOR ORDINARY DAILY WEATHER TELEGRAMS.—The advantages of this change are as follows :—

First.—The interval between 8 A.M. and 10 A.M. is the time of the day when the telegraphic wires in India are most free from traffic. The weather telegrams of the observations taken at 8 A.M. can hence be more quickly transmitted to Simla than those of observations taken at any other hour, and the great majority of the ninety-eight weather telegrams sent off at present daily from the observing stations be delivered in Simla before 10 o'clock, and the whole, except on extraordinary occasions, before noon. By this change of hour, which was adopted from the 1st of April 1888, the daily weather report is now printed on the afternoon of the day to which the observations refer, instead of on the following day, as has hitherto been the practice. This arrangement practically gives the Government the daily meteorological information supplied by the department from twelve to twenty-four hours earlier than has hitherto been possible, and officials in the Punjab, Madras and Bombay (served by the Bombay mail) 24 hours earlier information by post.

Second.—The Bengal Reporter by this arrangement receives all his urgent daily telegrams for the Bay of Bengal Report, issued daily at Calcutta for the information of the commercial community by 9 A.M. at the latest, and hence is able to prepare his daily report before his daily lectures at the Presidency College, and to issue it before 11 A.M. It is thus placed in the hands of the Calcutta Port Officials and the various subscribers belonging to the Calcutta commercial community at the commencement of the office day, instead of at 4 P.M. or 5 P.M. (or at the end of the office day) as has hitherto been the practice. This change has greatly increased the value of these reports, and is, I am informed, much appreciated by all those interested in them. The necessity for earlier publication was urged by several of the Calcutta newspapers in their remarks on the Balasore cyclone of May 1887.

Third.—The hour suggested, 8 A.M., is one of the hours at which observations of the barometer, wind, &c., are always made on board ships. Meteorological observations are rarely recorded at 10 A.M. at sea, and only under very unusual circumstances. Hence

the observations contributed by ships entering the ports of Calcutta and Bombay, and collected by the Calcutta and Bombay Meteorological Offices, have not hitherto been directly comparable with the land observations, as they are taken at different hours. This has deprived them of a great part of their value. One of the minor, but very important, improvements which the department has in view is the preparation and publication for at least two or three years of daily charts of the whole area including India, the Bay of Bengal, and Arabian Sea, as well as the Extra-Indian regions of Asiatic Turkey, Persia, Baluchistan, and Afghanistan, in which several observatories have been already established, and additions will probably be made during the next few years. In these charts the sea as well as the land observations will be duly and systematically entered. In this way a complete record will be obtained of the chief features of the weather, day by day, over the whole (land and sea) Indian area, and be filed for reference and discussion in the Central Office. The published data and charts will also be distributed to all meteorologists who are likely to undertake any investigations respecting the origin, character and variations of the air motion and rainfall of the south-west monsoon period in India, or any other cognate questions. Such investigations will, it may reasonably be expected, eventually throw light on the very important question, as to how far the strength of the south-west monsoon, and the distribution of the rainfall in India, are affected by the meteorological conditions over the sea area. That there are marked differences from year to year is evident to any one who has studied the cyclonic storms of the Bay of Bengal. Experience has shown that the storms of the Bay of Bengal have a fairly well-marked uniformity of character during each south-west monsoon period, but that they differ in character, number and line of march considerably from one year to another. It is possible, if not probable, that the peculiarities or abnormal features over the seas adjacent to India (of which the character of the cyclonic storms is one feature) may have as much to do in modifying the strength and field of the south-west monsoon, as snowfall on the Himalayas, or antecedent abnormal atmospheric conditions in India itself. A most important and necessary step in advance for this enquiry would be the adoption of the same hour for observation on land as on sea, and the preparation of the charts I have suggested.

Although there are several disadvantages attending a general change of hour of observation, the advantages, especially from the utilitarian standpoint of more rapid information respecting storms and earlier issue of storm warnings, are so great as to far outweigh the former. This change was introduced on 1st April 1888 as an experimental measure, and has proved on the whole very satisfactory, and will hence be continued as a permanent feature of the department from the end of the present year.

(C). THE TABULATION OF ALL OBSERVATIONS HITHERTO RECORDED IN A FORM ADAPTED FOR READY REFERENCE AND THE CALCULATION OF DAILY AVERAGES.—It may be premised that a very important principle in Indian meteorology is that the observations of some, if not all, of the elements should be much more accurately taken and recorded in India than in temperate regions. This statement or principle is based on the continuous experience of the last twelve years' work of the department. Many of the meteorological phenomena in India, such as the origin of a succession of cyclonic storms in the same part of the Bay, and their motion along nearly coincident paths and in the same direction (as for example the three cyclonic storms of November and December 1886), the tendency of heavy rainfall to repeat itself over the same

area during the greater part, or the whole of the south-west monsoon (as for example South Behar in the year 1886 and the area stretching from the Aravallis across Central Rajputana to the Rohtak, Delhi, Aligarh and Agra districts of the Punjab and North-Western Provinces and also the Central Provinces in the year 1887); the persistence of partial drought, or of almost entire absence of rainfall over large areas throughout an entire monsoon period or throughout the cold weather months in Upper India (as in 1886-87), are all phenomena of so pronounced a character, and on so large a scale, that if we believe in causation at all, it is certain there must have been present, before these prolonged abnormal and persistent periods of drought or of excessive rainfall, abnormal conditions; and if we could gauge and interpret these antecedent conditions, we should have the key to forecasting weather in India on a scale which has as yet not been attempted in Europe. Repeated examination has, however, shewn that these antecedent conditions or abnormal features, as imprinted upon the elements of meteorological observation, are comparatively small in amount in the land area of India, and hence very probably also over the sea area to even a greater extent than on land. In tropical countries it is the regular changes that are large and massive in character, whilst the irregular changes or abnormal features (except in the case of the greater cyclones of the Bay of Bengal and Arabian Sea) are small. Hence one of the chief problems of the meteorologist in India is the investigation of these small, but very significant, abnormal variations. Their determination requires that the normal or ordinary conditions should be known exactly. The careful comparison of the observations of the given day or period with the normal values or means will serve to determine the variations. This comparison is at present only possible roughly. Monthly means have been obtained, but what may be termed the normal or average conditions of each day or week of the year are not yet known. Some of the elements of observation occasionally change very rapidly, as, for example, temperature in Upper India in April and May, and the mean of the month cannot be taken as representing the normal condition at either the beginning or end of the month. Hence the daily report published by the Meteorological Office at Simla should not merely give the actual daily observations of pressure, temperature, &c., but also show how far these differ from the ordinary or normal values of these observations for the day. In this way accurate comparison and observation would go hand in hand. At present the former is not possible, as daily averages, except in the case of rainfall, have not yet been obtained. The Government of India sanctioned the employment of 16 temporary clerks from 1st April 1888 to the end of the year, in order that the data and observations already collected might be suitably tabulated, and daily averages of the more important elements of observations be calculated. The daily report next year will hence give the additional data of the variation of the actual observations from their normal values daily.

(D). THE EXTENSION AND IMPROVEMENT OF THE METHODS OF COLLECTING RAINFALL STATISTICS FOR THE INFORMATION OF THE GOVERNMENT OF INDIA, AND THE ADOPTION OF A UNIFORM SYSTEM OF RAINFALL REGISTRATION THROUGHOUT INDIA.

Rainfall is that element of meteorological observation the knowledge of which is of the utmost importance to Government, planters, merchants, &c. Rainfall is registered at all the meteorological stations, and also at a very large number of divisional and sub-divisional stations for the Provincial Revenue Departments. It is of course the simplest of all meteorological observations. Each province established its own method of taking

rainfall observations, and the information thus obtained is collected in various ways and published in the Provincial *Gazettes*. A small proportion only of the Revenue rainfall stations, in addition to the meteorological stations, have hitherto contributed rainfall data in various ways to the Central Meteorological Office. Some have reported daily for a part of the year by telegram, others by telegram weekly, and a larger number by post monthly. The information thus obtained by the Government of India of the rainfall in any province, as, for example, Bengal, is meagre as compared with that published in the Provincial *Gazettes*, and insufficient to give an approximately correct view of the distribution and variation of the rainfall district by district. The publication of the information by the India Meteorological Department has also been imperfect and fragmentary. The daily report gives a brief summary of the rainfall of the day, as indicated by the observations at the meteorological stations, and the weekly report a very brief analysis of the rainfall of the week based on the same data and the returns of about 29 selected rainfall reporting stations. The annual reports contain a discussion of the rainfall of the year based on information supplied by about 500 stations, but it is necessarily brief, and appears usually 18 months after the termination of the year to which it refers. It is therefore of little practical use to the ordinary public in India.

The defects of the present system are—

1st.—The paucity and imperfection of the rainfall information communicated to the Government of India, as compared with that received by the Local Governments.

The following table gives the number of stations in each province which report in any way rainfall to the Imperial and Local Governments:—

PROVINCE.	NUMBER OF STATIONS COMMUNICATING TO IMPERIAL.			NUMBER OF STATIONS COMMUNICATING TO PROVINCIAL.		
	Meteorological.	Revenue.	Total.	Meteorological.	Revenue.	Total.
Bengal	19	66	85	14	236	250
Assam	5	10	15	5	53	58
N.-W. Provinces and Oudh	5	43	58	15	241	256
Central Provinces	11	16	27	11	58	69
Punjab	13	31	44	11	167	178
Madras	17	61	78	15	299	314
Hyderabad, Mysore and Coorg	3	34	37	?	?	?
Bombay and States	15	39	54	9	226	235
Berar, Central India and Rajputana	15	53	68	?	?	?
Burma	11	20	31	8	22	30
TOTAL	124	373	497	88	1,302	1,390

The current rainfall information supplied to the Government of India is too small in amount to enable a fairly complete and accurate view of the distribution of rainfall and its variations from the normal amount to be obtained for an area which is about ten times as large as the British Islands, and in which the range of variation of the rainfall is

very much greater. The annual report on the rainfall of England published by Mr. Symons is, it may be added, based on returns furnished by upwards of a thousand observers.

The largest portion of the rainfall information collected by the India Meteorological Department is published in the Annual Report, which does not at present appear until 12 or 18 months after the termination of the year to which it refers, and in that publication the monthly totals and the variations from the average are given, and not the actual daily rainfalls, so that it gives an imperfect view of the distribution of the rainfall.

2nd.—There is an utter want of uniformity in the hours and methods of rainfall observation over India. In fact the measurement of rainfall was initiated provincially under the Revenue Authorities, and it has never been systematized for the whole of India. The following table gives the hours at which the rainfall is measured at the 497 stations observing and reporting rainfall to the India Meteorological Reporter, so far as it can be gathered from the information filed in the Central Office :—

Hours when rainfall was measured.	Number of Stations where measured.	Measured in Provinces.
Midnight (12 P.M.) . . .	5	Bombay and Madras.
Sunrise	2	Rajputana and Bombay.
6 A.M.	24	Rajputana, Bombay, Punjab, Central India, Bengal, Central Provinces, Berars, Hyderabad, Mysore and Burma.
6½ A.M.	1	Mysore.
7 A.M.	7	Bengal, Central Provinces, Hyderabad, Mysore and Burma.
8 A.M.	1	Hyderabad.
9 A.M.	2	Rajputana and Bombay.
9½ A.M.	1	North-Western Provinces and Oudh.
10 A.M.	26	Punjab, Rajputana, Central India, North-Western Provinces and Oudh, Bengal, Assam, Central Provinces, Madras and Burma.
12 A.M.	19	Madras.
6 A.M. & 6 P.M. . . .	8	Punjab, Rajputana, Assam and Burma.
10 A.M. & 4 P.M. . . .	9	Rajputana, Bengal, Central Provinces, Madras and Burma.
10 A.M. 4 & 6 P.M. . .	1	Bombay.
10 A.M. 4 & 10 P.M. . .	4	Hyderabad and Madras.
10 A.M. & 6 P.M. . . .	7	Punjab, Rajputana, Central India, North-Western Provinces and Oudh, Central Provinces, Berars and Bombay.
4 P.M.	16	Punjab, Rajputana, Central India, North-Western Provinces and Oudh, Central Provinces, Berars and Burma.
5 P.M.	4	Rajputana, Central India and Bengal.
6 P.M.	167	Punjab, Rajputana, Central India, North-Western Provinces and Oudh, Bengal, Assam, Central Provinces, Berars, Bombay, Madras and Burma.
6½ P.M.	1	North-Western Provinces and Oudh.
10 P.M.	5	Madras and Mysore.
Different times	1	Punjab.
Hours not registered . .	186	Punjab, Rajputana, Central India, North-Western Provinces and Oudh, Bengal, Assam, Central Provinces, Berars, Hyderabad, Bombay, Madras, Mysore and Burma.
TOTAL	497 311	

A striking illustration of the difficulty of having to deal with unsystematized observations came to my notice during the past year. Mr. Blanford some time ago took up the question of the influence of forests on rainfall, and found apparently very strong evidence in the rainfall statistics of the Central Provinces. The results of his investigations were given in the last Administration Report (pages 12 and 13 of the Report for 1886-87). If the rainfall returns of that province for the past 20 years could have been accepted as true, they would have established most conclusively that the extension of forests had been accompanied by a marked increase in the average rainfall of the forest districts, and that these changes stood probably in the relation of cause and effect. The conclusion, if fully established, would have been of great importance. Mr. Blanford, in order to assure himself of the value of the rainfall returns he employed in the discussion of the Central Provinces, wrote to the Chief Commissioner on the subject. The following is an extract from the reply of the Secretary to the Chief Commissioner :—

“The Chief Commissioner fears that the records of rainfall registered in the Revenue Department of these Provinces for years previous to 1883 cannot be accepted as altogether reliable. At ten of the stations for which you quote figures, the rainfall has been since 1869 registered at observatories in the charge of the Medical Department, but the Deputy Surgeon-General is unable to state whether the pattern of gauge has remained unchanged in those observatories since the year of their transfer to his Department, though it has certainly remained unchanged since 1876. As regards the registration effected in the Revenue Department, it is to be remarked that previously to 1887, the instruments which were used were either the Rurki rod and float, or the square self-registering gauge. In 1877 a number of Symons' gauges were distributed, but in 1883 it was found that a considerable proportion of the gauges in use were of one or other of the old patterns; and, moreover, that registration was frequently effected in a very careless fashion. Since that year (1883) matters have been on a more satisfactory footing, but the statistics which were previously collected would form an unsafe basis for generalization.”

Hence one result of the unsystematic registration of the rainfall in the Central Provinces is to postpone the decision of the influence of forests on rainfall in that area for another twenty years. It is only one of the many cases that occur in the Meteorological Department, and to which it is unfortunately more exposed than other Scientific Departments, of the worthlessness of unsystematic observation.

Hence I proposed in my Note to the Government of India :—

1st.—To introduce a uniform system of rainfall registration over the whole of India, and to select some definite hour, for example 8 A.M. or 10 A.M., as the hour for daily measurement throughout India.

2nd.—To increase the amount of rainfall information supplied to the Government of India, and to publish it in a more complete form than at present. The method in which, it was suggested, this should be done was as follows. The unit for the collection of rainfall information should be the district. Daily rainfall observations are taken at the Collector's head-quarters, and at the various sub-divisional stations at which rain-gauges are maintained. The latter returns could be sent at the end of the meteorological week by post to the Collector's office. From this information a deferred telegram (by the aid of the Code in use) could be prepared, which would give the daily rainfall and total rainfall of the week at the head station, the average district rainfall for the week, and the highest and lowest total rainfall for the week in the district. This telegram would not cost more than a rupee, and it would give very full information of the character of the rainfall in that district. It would give the time

distribution of the rainfall (as shewn by the daily rainfall at the sudder station), the average rainfall in the district, and the range of variation in the rainfall throughout the district during the week. There are about 255 such divisions (*i.e.*, Collectors' districts or areas corresponding to them) as shewn below :—

	No. of Districts.
Burma	29
Bengal	47
Assam	11
Central Provinces	20
North-Western Provinces and Oudh	49
Punjab	31
Bombay	25
Madras	19
Districts not included in the above	24
Total	<u>255</u>

If the information were received weekly in the Simla Meteorological Office, it could be compared with the normal averages, and the whole information published with a discussion in a compact and simple form weekly, and if possible with a lithographed chart to show the most important part of the information at a glance. This report would take the place, or rather be the expansion of, the present weekly report.

In November 1887 I proposed that, as an experiment, rainfall statistics for the south-west monsoon of 1888 should be collected and published in the manner proposed above. This was sanctioned, and the experience of the first six weeks of the present monsoon has shewn that it is a great improvement, and it will hence probably be adopted permanently from next year.

These are the larger changes which were sanctioned during the official year 1887-88 and were effected either from 1st January 1888 or during the current year.

INDIA DAILY WEATHER REPORT AND CHART.

Shortly after I took over charge from Mr. Blanford a series of improvements were effected in the daily report. The size of the sheet was considerably reduced, and the whole matter published in a more compact form. During the previous two years the preparation of the report had been entrusted almost entirely to the youngest officer in the department. As it is that part of the work of the department which comes most frequently before Government and the public, and is one in which experience is especially valuable, the arrangements for its preparation which were in force when I took over charge were considered to be not altogether satisfactory by Government. It has hence been arranged that in future, except under very exceptional circumstances, and then only during the fair season, the work shall be done either by the Meteorological Reporter himself or by the First Assistant Meteorological Reporter, who has had a lengthened experience and training in such work at the London Meteorological Office. A fuller and more complete summary of the observations is now given in the daily report, the object of this being to enable any one to ascertain without reference to the columns of figures representing the actual observations, all the more prominent and important features and indications of the weather of the previous 24 hours, together with the chief inferences of the probable weather of the next 24 hours, so far as they can be based on the observations and on the

experience and knowledge of the officer drawing up the report. This is of no great practical utility at present, except in the case of cyclonic storms, inasmuch as it is not possible to disseminate the knowledge quickly enough to be of value to the agriculturist whom it chiefly concerns. It is, however, a direction of desirable extension, and may form the commencement of an important and useful addition to the work of the department hereafter. While making these changes, I pointed out to Government the desirability of adding a chart to the daily report, as it would convey to the public for whom the report is chiefly intended far more quickly and intelligibly than either figures or words the more important features of the weather, and of the observations sent by telegram and published in full in the daily report. The suggestion was not only approved, but I was asked to submit proposals and make the necessary arrangements for its introduction as quickly as possible. I went down to Calcutta in July 1887 to purchase the lithographic presses, and to arrange for the printing of a sufficient supply of forms containing a blank map of India on which to print the meteorological data day by day. Colonel Waterhouse, Superintendent of the Lithographic Branch of the Survey of India, gave me ready and valuable assistance, and prepared a very neat chart and undertook to make arrangements to supply, as required, the necessary number of forms. It was only possible to arrange for a limited supply at first. Fifty copies of the daily report and chart were issued to the Government officials in Simla and certain selected Government officers elsewhere from the 1st of September 1887 to the 31st of March 1888.

During the cold weather arrangements were completed for the supply of the lithographed chart forms at the rate of 250 copies per diem by Colonel Waterhouse, and the daily report, with a chart, was issued from the 1st of April 1888 to 228 Government officers in all parts of India, and to a limited number of Meteorological Bureaus and authorities in Europe and America.

The daily report and chart in its present form will now compare not unfavourably with those published by the Meteorological Bureaus of England, France, Italy, Algeria, Austria, Germany, Australia, and the United States, which are, so far as I am aware, the only States that issue daily weather reports with charts. The India charts will, I believe, be of unique value to meteorologists as they are the only ones which deal almost entirely with a tropical region. They give in a handy and easily intelligible form the daily changes of weather in a country which possesses the double interest of being mainly tropical, and of being the most striking example of the semi-annual system of meteorological changes known in India as the south-west and north-east monsoons. The following is the summary of the Distribution List as it stood on the 1st of April 1888:—

1. Government Officers	228
2. Subscribers in India	0
3. Meteorological Societies and Departments in Europe or America	24
4. Distinguished Meteorologists	3
5. Filed in office for future supply or use	4
Total printed daily on April 1st, 1888	<u>259</u>

STORM-WARNING SYSTEM.

This work has been carried out during the past year by the Meteorological Reporters at Calcutta and Bombay.

Mr. Pedler's duty at the commencement of the official year 1887-88 was to warn—

- (1) Calcutta and the River Hooghly.
- (2) Chittagong.
- (3) The Orissa Ports including

{	False Point.
	Pooree.
	Balasore.
	Chandbally.

Mr. Chambers warned the ports of—

- (1) Bombay.
- (2) Kurrachee.
- (3) Ratnagiri.
- (4) Bhavnagar.
- (5) Daman.
- (6) Karwar.
- (7) Vingorla.
- (8) Goa.
- (9) Kumta.

During the year 1886-87, the question of including under one system the warning of all ports in Burma and Madras as well as the Bengal and Bombay ports was partially dealt with by Mr. Blandford. He drew up and introduced a general system of signals and instructions for their use for the guidance of Port Officers. The Burma and Madras Governments acquiesced in the arrangement, and sanctioned the purchase and erection of the necessary apparatus for hoisting the storm signals. It was intended to assign the duty of warning the Madras ports on the Malabar Coast (Mangalore, Calicut, and Cochin) to the Bombay Reporter, and that of warning the Burma ports and the Madras ports on the Bay of Bengal to the Bengal Reporter. As the Burma ports were provided with the apparatus in the beginning of 1887, Mr. Blandford, shortly before he went on furlough, made the final arrangements for the commencement of the work on that coast, and obtained sanction for the additional telegraphic expenditure required and for the establishment of an observatory at Tavoy. The apparatus for hoisting the storm signals was not ready at the Madras ports until nearly the end of the year 1887. Mr. Pedler warned the Port Officers of Gopalpur, Vizagapatam, Cocanada, and Masulipatam informally during the year 1887 of the existence of all storms in the Bay likely to give bad weather to that part of the west coast on which they were situated.

When I was asked, as Meteorological Reporter to the Government of Bengal in November 1886, by the Government of India to undertake the additional work of warning the Burma and Madras ports, I at once accepted, but pointed out certain difficulties in the way of carrying out the work successfully, and suggested certain changes I considered necessary to place the system on a satisfactory footing. These I was fortunately enabled to deal with during the past year, and to place the complete system of storm-warning for the Burma, Bengal and Madras coasts on what appears to be a satisfactory basis.

The first suggestion I made was the necessity for special arrangements ensuring rapid and certain telegraphic communication between the Calcutta weather office and the distant Port Officers and Observatory Superintendents at the Burma and Madras ports during stormy weather. The necessity for rapid communication I pointed out is much greater in the case of the Calcutta than in that of the Bombay Reporter. The Bombay Reporter is a whole-time officer, and his most distant ports to be warned, *viz.*, Kurrachee and Cochin,

are at distances of about 550 miles and 650 miles from Bombay in a direct line. The Bengal Reporter is engaged during a large portion of ordinary office hours at the Presidency College, Calcutta. The most distant ports to be warned by him under the extended system are Moulmein, distant 750 miles, and Tuticorin, 1,200 miles in a direct line. The telegraphic communication between Bengal and Burma is much more uncertain than between Bombay and the other west coast ports, as large portions of the lines run through jungle and very thinly populated districts. These facts appeared to establish that the Bengal Reporter was requested by the Government of India to take up a much larger extension than the Bombay Reporter, and to work it under far less favourable conditions for success, and were the chief reasons I urged for special telegraphic arrangements. Fortunately my remarks were emphasized by the event of the Balasore cyclone in May 1887. During the formation of that storm, and from May 19th, the Bengal Reporter received no telegram from the Diamond Island Observatory, the only one which under the existing system gives certain intelligence of the formation and growth of storms near the Andamans. Hence arose some doubt as to the exact course and the strength of the storm, and perhaps some slight delay in the hoisting of the signals at the Hooghly river stations.

The Telegraph Department recognised the necessity for more rapid communication in the case of the distant Burma and Madras ports, and agreed that ordinary urgent telegrams would not always be sufficiently rapid, as there might be delay in case of pressure of work, such for example as occurred on the Burma lines in the cold weather of 1886-87. After some consideration, it was agreed to give precedence to urgent weather messages during storms and to storm-signal telegrams between Calcutta and the Burma and Madras port offices and the larger and more important Burma and Madras observatories (including Rangoon, Bassein, Moulmein, Chittagong, Akyab, Madras, Masulipatam, Gopalpur, Vizagapatam, and Negapatam). The number of such messages in the course of the year will be very small, and they will hence not interfere at all with the convenience of the public, whilst the concession will generally enable the Bengal Reporter to warn ports on the Burma and South Madras coasts some hours earlier than would otherwise be the case. The concession by the Telegraph Department is hence very valuable, and is the latest instance of its readiness to afford every aid and facility to the Meteorological Department in carrying out this practical and important part of its work.

The extension of the storm-warning system to the Madras coast involved several difficulties which have been as yet only partly solved. According to the proposed arrangement it was intended that Mr. Chambers should warn the Malabar ports of Madras. Mr. Chambers has, however, for many years pointed out that the means at his disposal are inadequate to enable him to warn the Bombay ports effectively and with certainty. As it is a great mistake to assign inadequate means to an officer for the performance of an important duty such as that of warning the ports on a long line of coast of the approach of cyclonic storms, or to continue to entrust the duty to one who expresses periodically his opinion of the inadequacy of the means at his disposal, I went down to Bombay at the earliest opportunity after I took over charge of the Department (*i.e.*, on my return from Simla to Calcutta at the end of October) in order to discuss the subject with Mr. Chambers, and to ascertain his minimum requirements for the performance of his storm-warning duties to his own satisfaction, and the safety of the shipping frequenting the Bombay ports. Mr. Chambers suggested, as absolutely essential, the extension of the number of stations reporting to

him by daily weather-telegrams from 11 to 28, and the re-arrangement and slight increase of his office staff, to enable him to deal with the observations more effectively and easily than hitherto. His proposals were practically identical with those originally submitted by him to the Government of Bombay in September 1879, and involved a permanent yearly increase of his annual budget grant for storm-warning work from about R8,800 to R23,000.

The Port authorities at Bombay and the Bombay Government have been apparently satisfied hitherto with the present arrangements, as no suggestion had been received up to the end of the official year 1887 from them, urging or indicating the necessity of improvements or calling attention to the insufficiency of the present system.

Some time ago Mr. Chambers, in a letter to Mr. Blanford, expressed his opinion that with the arrangements then in force, the Bombay ports could be more effectively warned from Simla than from Bombay. Mr. Blanford consulted with Mr. Dallas as to the expediency, but although both considered it feasible, Mr. Blanford deemed it advisable for certain reasons not to make the change at that time.

In the beginning of 1887 the Finance Commission, on the score of economy, recommended the reduction of the Western India Reportership from the status of a whole-time to a local appointment, and thus place it on the same footing practically as the other Provincial Reporterships. The final decision was postponed by the Government of India until the end of the year 1887. I received Mr. Chambers' proposals in November 1887, and as they involved a large increase of expenditure, I did not think it advisable to forward them for consideration at a time when economical administration was considered of great, if not of primary importance, more especially as I was unable to recommend Mr. Chambers' scheme, however efficient it might have been when carried out under his direction, as an economical permanent addition to the cost and working of the Department. Mr. Chambers' proposal, it may be stated, involved the transmission of two sets of twenty-eight identical weather telegrams to two different offices (*viz.*, Simla and Bombay), the reduction and tabulation of these telegraphic observations at these two offices by two sets of clerks, and the critical examination of the same observations by two different scientific officers. In other words, the whole of Mr. Chambers' storm-warning work, so far as it related to the tabulation, reduction and examination of the observations, &c., is done daily in the Simla Office. Unless the strongest reasons could be assigned for such an arrangement, it can only be considered an expensive arrangement to have the same work done twice over in two different offices. I could find no reasons of this kind in the correspondence on the subject between Mr. Blanford and Mr. Chambers, and the latter officer had furnished the Government of India with a very strong reason against the extension. The weather telegrams at Bombay had been utilised solely for the purpose of warning the Bombay ports, and Mr. Chambers had himself expressed the opinion that the work could be done as well from Simla as hitherto from Bombay, and therefore, it might be fairly assumed, to the satisfaction of the Port authorities and mercantile public.

It might be argued against the Simla arrangement that it would not be safe for Bombay to rely for its storm warnings on an officer at so distant a station as Simla. Telegraphic communication might be interrupted during a storm, and the warning fail to reach the port. This, however, is a contingency which must be faced in all storm-warning systems, and to which Kurrachee and the other west coast ports excluding Bombay are liable by the present arrangements. European practice is opposed to the

system of decentralization which has prevailed hitherto more or less in the India Meteorological Department. For example all the ports in England, Scotland and Ireland are warned from one central office in London. Similarly, in France, all the French ports, Marseilles, equally with Cherbourg and Calais, are warned from a central town—Paris, which is not even a sea port; and all the sea ports of the United States, the Pacific as well as the Atlantic ports, are warned from Washington. The experience of many years, I may add, has shown that the probability of such a failure of communication between Bombay and Simla is very small, and that it may by special arrangements be diminished still further, as the Telegraph Department have shown the greatest willingness to give the Meteorological Department every assistance and facility for carrying out the storm-warning work successfully. The practice of wealthy countries like England, France and the United States suggests strongly the desirability of concentrating that most responsible and onerous work in the Central Office, unless there are special reasons for localizing sub-offices or provincial offices such as exist at present for Calcutta and Bengal.

Mr. Chambers' proposals would have doubtless made his weather-reporting and storm-warning arrangements more satisfactory and perfect than hitherto, but I was unable to recommend them as the most economical as well as efficient arrangement for carrying out the west coast storm-warning work as proposed at that time by Mr. Chambers. Hence, until the future status of the Bombay Meteorological Reporter had been decided, it appeared to be undesirable to bring up the question of this large extension proposed by Mr. Chambers. I asked, therefore, that officer to take up the additional work of warning Cochin, Mangalore and Calicut as part of the Bombay storm-warning system which was introduced in 1879, and he at once consented. The Government of India finally decided in March 1888 to reduce the Reportership for Western India from a whole-time to a Local Reportership with effect from the 1st of August 1888, when the whole question of the storm signal service arrangements will probably demand reconsideration.

The arrangements in force at the end of the official year 1887-88 were hence as follows:—

The Bengal Reporter warned the following ports:—

- (a) Bengal ports—
 - Calcutta and River Hooghly.
 - Chittagong.
 - Orissa ports, including Pooree, False Point, Chandbally and Balasore.
- (b) Burma ports—
 - Moulmein.
 - Rangoon.
 - Bassein.
 - Akyab.
- (c) Madras ports—
 - Bimlipatam.
 - Gopalpur.
 - Vizagapatam.
 - Cocanada.
 - Masulipatam.
 - Madras.
 - Negapatam.
 - Tuticorin.

The Bombay Reporter warned—

- (a) Bombay ports—
 - Kurrachee.
 - Bhavnagar.
 - Daman.
 - Bombay.
 - Ratnagiri.
 - Goa.
 - Karwar.
 - Vingorla.
 - Kumta.
- (b) Madras ports—
 - Cochin.
 - Mangalore.
 - Calicut.

The warning signals are hoisted at the signal stations of Bengal (*i.e.*, at Calcutta, Chittagong and the Orissa ports) by the direct orders of the Meteorological Reporter of Bengal, and at the Bombay ports, *i.e.*, at Kurrachee, Bhavnagar, Daman, Bombay, Ratnagiri, Goa, Karwar, Vingorla and Kumta, by the orders of the Meteorological Reporter for Western India.

The arrangements for the Burma and Madras ports may be described as follows :—

The Port Officers are responsible for the hoisting of the signals, but are guided by the information sent by the Meteorological Reporters, who have received instructions to telegraph fully, at frequent intervals during stormy weather, details of the storm to the ports it is likely to affect, and to give every information and assistance to Port Officers to enable them to hoist the storm signals as soon as is advisable for the protection of the shipping in their ports. This will usually be sufficient to enable the Port Officer at any port to hoist the storm signals so as to give ample warning to all shipping in the port, but if telegraphic communication between that port and the head-quarters of the Meteorological Office with which he corresponds be suspended, the Port Officer is then instructed to rely upon his own judgment, and to hoist the storm signals from the indications of his barometer, strength of the wind, force of the sea, &c. By these arrangements any collision between the Meteorological Reporter and Port Officer is avoided, and each officer is assigned the duty he is best qualified to perform. To a capable officer on the spot—the Port Officer—is assigned the duty of hoisting the storm signals whenever they appear to be necessary, whilst the Reporter is instructed to advise freely and fully, and give him the more exact and complete information that is obtained by collecting and considering the observations of a large number of stations.

The following is a copy of the arrangements actually adopted for warning the Madras ports, as drawn up by the Port Officer, Government Astronomer, and myself, and approved by the Madras Government :—

1. The arrangements for the communication of information respecting the formation, growth and course of cyclonic storms to Port Officers, necessary for their guidance in hoisting the storm signals, will be carried out by the Meteorological Reporters of Bombay and Calcutta under the general direction of the Meteorological Reporter to the Government of India.

The Madras ports which will be included in this storm-warning system are as follows :—

A.—Ports on the Coromandel Coast—

Gopalpore.	Cocanada.	Porto Novo.
Calingapatam.	Masulipatam.	Tranquebar.
Bimlipatam.	Madras.	Negapatam.
Vizagapatam.	Cuddalore.	Tuticorin.

B.—Ports on the Malabar Coast—

Cannanore.	Mangalore.	Calicut.
Tellicherry.	Cochin.	Beypore.

The Meteorological Reporter to the Government of Bengal (Calcutta) will supply the information and work the system for those ports classed as belonging to the Coromandel Coast, and the Meteorological Reporter for Western India (Bombay) for the Malabar Coast ports as defined above.

2. Information respecting the first indications of bad weather in the Indian Ocean will be sent by the Bombay Reporter, and of bad weather in the Bay of Bengal by the Calcutta Meteorological Reporter, to the Port Officer, Madras, who will, if he deems it desirable, communicate it to any of the Port Officers subordinate to him.

3. As soon as the existence and probable course of a cyclonic storm in the Bay of Bengal or Indian Ocean has been ascertained by the Meteorological Reporter of Calcutta or Bombay, the Port Officer of each of the ports likely to be affected by the storm will be informed and warned by the Reporter appointed to give such warnings to his port. The warning signal will usually be hoisted immediately or shortly after the receipt of this information. The Meteorological Reporter will continue to keep the Port Officers of the warned ports acquainted with the growth, progress, course and other features of the storm, which will be useful as a guide to them in hoisting, when necessary, the danger signal. The danger signal will be hoisted as soon as the Port Officer considers it advisable to warn the shipping of an approaching cyclone, in order that the masters of vessels may carry out the precautions or follow the directions laid down in the Port Rules of the port where they are lying.

By these arrangements the Meteorological Reporters will transmit information and warnings direct to the Port Officers of Madras, Gopalpur, Bimlipatam, Vizagapatam, Cocanada, Masulipatam, Negapatam, Tuticorin, Mangalore, Cochin and Calicut. At the remaining ports, *viz.*, Calingapatam, Cuddalore, Porto Novo, Tranquebar, Cannanore, Tellichery, and Beypore, where the signals will be hoisted by the Port Conservators, the Port Officer, under whom they are immediately placed, will instruct them by urgent telegrams to hoist the warning and danger signals at the same time that they hoist them at their own ports. By this arrangement information respecting bad weather and directions relating to the hoisting of storm signals will be communicated to the Port Conservator of Calingapatam by the Port Officer of Gopalpur, to the Port Conservators of Cuddalore, Porto Novo and Tranquebar by the Port Officer of Negapatam, to the Port Conservators of Cannanore and Tellichery by the Port Officer of Mangalore, and to the Port Conservator of Beypore by the Port Officer of Calicut.

4. It should be clearly understood that the duties of the Meteorological Reporters of Bombay and Calcutta are confined to furnishing as definite, full, and early information as possible of the character, position, course, probable time of approach and varying phases of cyclonic storms to the Port Officers of all ports to which these storms will probably cause dangerous weather and a high sea. The responsibility of hoisting and taking down the storm signals rests solely with the Port Officers. They will usually be guided mainly by the information received from the Meteorological Reporter; but if that information be insufficient or be delayed in transmission, or if telegraphic communication be suspended by breaks in the lines, the Port Officers will be guided by the indications of the barometer, force of the wind, state of the sea, and general aspect of the weather.

5. A memorandum of storm prognostics will be drawn up by the India Meteorological Office, and a copy be sent (as well as all subsequent additions and alterations) to each Port Officer to assist him in deciding when to hoist the storm signals on the approach of a cyclonic storm, more especially in the case of failure of telegraphic communications.

6. The storm signals to be employed are of two kinds—one for day use, and the second for use at night. They are as follows:—

1st.—Day signals—

No. I.—Bad weather or warning signal—*A Ball.*

No. II.—Storm or danger signal—*A Drum.*

2nd.—Night signals—

No. I.—Bad weather or warning signal—*Three white lights arranged in a vertical line.*

No. II.—Storm or danger signal—*Two white lights arranged in a vertical line.*

The *Ball* or *three white lights* when hoisted indicates that a cyclonic storm has formed which will probably advance to that part of the coast on which the port is situated, but is still at a considerable distance from it.

The *Drum* or *two white lights* when hoisted indicates that a storm of considerable magnitude is approaching that part of the coast on which the port is situated, and will shortly cross the coast.

7. In order to facilitate and expedite the working of these arrangements, the Telegraph Department has granted the privilege of *Precedence urgency* to telegrams referring to stormy weather and the hoisting of storm signals between the Meteorological Reporter of Calcutta and the Port Officers and Meteorological Superintendents of Cocanada, Gopalpur, Madras, Masulipatam, Negapatam and Vizagapatam. The names of other officers will be added to this list as found necessary.

for the proper working of the system. Instructions for the preparation and despatch of the telegrams in proper form, in order to secure priority of transmission to ordinary urgent messages, will be sent by the India Meteorological Office to the various officers permitted to send them.

8. Copies of all telegrams despatched to Port Officers other than the Port Officer, Madras, relating to the approach of cyclonic storms, will be sent at the same time to the Port Officer, Madras, in order that he may be kept fully acquainted with the weather information and instructions communicated by the Meteorological Reporter to the Port Officers subordinate to him.

9. The Port Officer, Madras, will communicate all meteorological information received during storms from the Government Astronomer, Madras, to the Calcutta Meteorological Reporter for his information.

10. Port Officers noting the appearance of suspicious weather before the receipt of any telegram from the Meteorological Reporter co-operating with them, should communicate the information without delay to that officer.

11. All the Port Officers receiving telegrams from the Meteorological Reporters during a storm should send a brief statement, after the cyclone has passed away, of the telegrams received from the Reporter, and of the exact time when they were delivered by the telegraph offices, in order that the Meteorological Department may exercise an effective check over this part of the working of the system, and secure the necessary rapidity of telegraphic communication required for the proper working of the system.

STORM OBSERVATIONS.

Amongst the minor proposals I made to Government, and which are as yet under consideration, was one for securing satisfactory storm observations. Observers have been paid hitherto only for taking the regular periodic observations. They have been urged at various times to take extra observations during storms, but as that work is very irksome, and necessitates exposure to heavy rain, strong winds, and bad weather, and does not entitle the observer to extra pay nor diminish his pay if it be left undone, these observations have been systematically neglected. The observers had of course the excuse that these observations were not only very troublesome, but that they were really not part of their duty for which they were employed and paid. Mr. Blanford, some years ago, in order to improve the position of observers, obtained the sanction of Government to the grant of a number of special allowances of Rs 5 and Rs 10, which were allotted annually to observers for prolonged good service and for accuracy of observation. But in assigning these allowances no regard was paid to the claims of extra observations. They were allotted to observers who, however accurate their ordinary work might have been, never, in the great majority of cases, stepped beyond the limits of the regular work of observation. In meteorological enquiry, accuracy of observation, it would naturally appear, should be considered to denote accuracy of observing the most important facts and features of the weather, and not be restricted merely to accuracy of regular observation of matters which are frequently of comparatively little importance. In this respect our observers have signally failed. To give one or two recent examples. The Balasore cyclone of May 1887 passed close to Hazaribagh. The observer did not take a single extra observation. The cyclone of October 1886 passed near the observatories of Cud-dapah, Belgaum and Bellary. In drawing up the report of that cyclone the only observations available for that part of its course were the regular observations and no more.

This aversion to recording storm observations is undoubtedly partly due to the want of interest taken by many of our observers in their work, which makes constant watchful supervision an absolute necessity. The necessity for a change in this direction has been

strikingly shown by the experience of the hot weather of the present year. It has been remarkable for the occurrence of some of the most violent hot weather storms or tornadoes of recent years. Among them may be mentioned—

Dacca.	Cawnpore.	Serampur.
Delhi.	Moradabad.	Pubna.

The first of these was exceptionally violent, and passed within a few hundred feet from one of our meteorological observatories. Notwithstanding this, not a single extra observation was taken, nor has any meteorological information been obtained which throws any light on its origin. No special information was received from the observer, except the intimation in the regular daily telegram that there had been a tornado, a statement which is occasionally made by our observers when a somewhat more severe thunderstorm or nor-wester than usual happens. A series of observations taken at brief intervals during the tornado at Dacca would have been of the highest interest, and might have been almost invaluable if they had helped to throw light upon the formation and character of the tornado.

The special allowances have hence failed to arouse the intelligent interest of our observers in their work, such as would have been shewn by the careful registration of observations during storms. I do not think they have even secured any marked improvement in the regular observations, and my experience in this respect is confirmed by that of Messrs. Hill and Pedler. Accuracy of observation has been, and will probably in future be, secured and maintained chiefly by constant scrutiny of the observations, and the rejection of all doubtful ones. The allowances have also given rise to a considerable amount of heart-burning, and those who have once received them think they have established a claim to them for the future, and those who do not receive them, think they ought to have them, and are disappointed at not receiving them. They have also apparently introduced two standards for accuracy of observation—an ordinary standard for which the observer is entitled to full pay, and a higher and meritorious standard for accuracy in the same class of observations (and not for extra observations for which a special reward or payment might naturally be expected) rewarded by special allowances. That the special allowances do not act as a certain stimulus to improved and more accurate work, may be shown by the fact that in several cases it has been found necessary to suspend or withdraw them for brief periods during the past two years.

As they have not effected any of the objects for which they were established and have neither secured extra storm observations, nor improved the ordinary observations, I proposed to Government that they should be discontinued, and the sum thus saved be devoted to payment for extra observations, and the principle has been accepted by the Government. During the year 1888, from April to December, the amount thus saved (Rs. 3,000) will be allotted to paying the observers for the extra 8 A.M. observations which are telegraphed daily to Simla. Next year, when these observations, if continued, will form part of the regular and permanent work of the department, the amount hitherto devoted to special allowances, *viz.*, Rs. 3,000, will probably be utilized for the payment of observations taken during storms, sent in full to the Calcutta Office, and a brief resumé telegraphed to Simla for the daily report. These storm telegrams, if adopted, will supply valuable information, and remove a serious defect from the present daily report, *viz.*, the absence of information respecting severe storms at the time of their occurrence.

As I have referred to the interruptions of the Diamond Island line, I may state here that I was informed by the Telegraph Department they were mainly due to falling trees. The line runs through a very narrow belt of cleared forest jungle, the belt not being wide enough to prevent trees in high cyclonic winds from falling down and injuring or breaking the line. The Court of Enquiry on the loss of the *Sir John Lawrence* which sunk with about 800 passengers on 25th May 1887 during the Balasore cyclone of 1887, recommended—

- (1) That the Diamond Island line should be put into proper order.
- (2) That Port Blair should be connected telegraphically with India and weather telegrams be forwarded,

The first of these proposals has been sanctioned and a sufficient width of forest has, I believe, been already cleared to prevent interruption in future from falling trees. The second proposal has been postponed on account of want of funds.

PUBLICATIONS.

The annual report for 1885 was taken up earlier than usual. The whole of it was finished by August 1887, but the printing of so large a volume of tables and numerical matter always requires a long time. The report was hence not ready to lay before Government until January 1888. This was however four months in advance of the publication of the previous annual report. The report for 1886 appeared in the same form as that of previous years and discussed the chief features of the meteorology of the year under the same heads as before.

The charts of the Arabian Sea prepared by Mr. Dallas from the data collected by the Board of Trade from ships navigating that sea during the period 1855—78 were published during the year in exactly the same form as the charts of the Bay of Bengal. This completes the most important part of the work respecting the Indian seas handed over to Mr. Dallas.

Several parts of the Indian Meteorological Memoirs were issued during the year :

The second part of Mr. Blanford's memoir on "the Rainfall of India" was issued in October 1887.

The third part is now complete and is being issued (May 1888).

The fourth part is in the press, and is nearly ready and will shortly be published. This will complete the subject and also the third volume of the Memoirs which will contain the whole of Mr. Blanford's valuable monograph on "the Rainfall of India."

Part IV of Volume IV, giving a list of storms during the years 1882-86 with brief descriptions, similar to the list published in Part VI, Volume II, and intended as a continuation of that list bringing information up to date, and followed by a full account of the three cyclones of November and December 1886 in the Bay of Bengal, was issued in February 1888.

An account of the Balasore cyclone of May 1887 was prepared as the first part of a new publication of the Department, called the Cyclone Memoirs, which form has been adopted with the sanction of the Government of India. It was issued in January 1888.

In addition to these memoirs, the following are in preparation :—

- (1) Mr. Chambers' report of the cyclone of May and June 1881 in the Arabian Sea.

- (2) Hand-book of Cyclonic Storms in the Bay of Bengal, for the use of sailors, which is nearly ready for the press. It may be mentioned that the greater part of this was ready twelve months ago, but that it was considered desirable to postpone its publication until the question of the permanent adoption of 8 A.M. as one of the hours of recording observations at all stations was settled.
- (3) Analysis of the cold-weather storms in Northern India during the period 1876-1888.

The publication of an account by Mr. Chambers of a cyclone which occurred nearly seven years ago, seems to require some explanation. The following states briefly the circumstances:—Mr. Blanford, when the Department was reorganized in 1875, suggested the appointment of a whole-time officer in Bombay instead of a local Reporter as had been done in Calcutta, Allahabad, Madras and the Punjab. His first duties were the organization of the observatories in Western India (*i.e.*, Bombay, Berars, Western Rajputana, and Central India). Afterwards when this work was completed it was intended that he should take part and assist the Head of the Department in carrying out the scientific investigations of the department. Mr. Blanford suggested, some years ago, to Mr. Chambers that he should take up the cyclonic storms of the Arabian Sea. Their chief features were, in Mr. Blanford's opinion, little known, and an investigation would probably result in valuable practical information for sailors, as well as throw light on their origin, and also probably on the general character of the south-west monsoon. The work was postponed for several years, as Mr. Chambers urged that his office was too small to undertake the extra labour of dealing with the storm observations, and that he was himself engaged in other and more important scientific investigations.

The following extracts from orders of the Government of India, dated October and December 1881, show fully the opinion and wishes on the question of the Government at that time:—

"Some twelve months ago Mr. Chambers was requested by the Meteorological Reporter to the Government of India to prepare a report on past storms which have occurred in the Bombay Presidency. This he has objected to compile, partly because the duty would interfere with the private researches which he is pursuing in connection with a storm-warning system, partly on the plea of insufficient office establishment, and partly through a misconception of the magnitude of the work"; and "the special work to which Mr. Chambers has been directed to turn his attention is a report on past cyclonic storms, and the Government of India sees nothing in Mr. Blanford's requisition which is either unreasonable or incompatible with the performance of Mr. Chambers' ordinary official duties."

In December 1885 Mr. Chambers obtained an addition of two clerks to assist him in his meteorological investigations. During the next year, he contributed nothing to the work of scientific meteorological investigation as published in the Meteorological Memoirs of the Department, or in the direction which Mr. Blanford thought he ought to work. At last, when the question of the future maintenance of the Western India Reportership as a whole-time or a local appointment was under consideration, the Revenue and Agricultural Department of the Government of India, through Mr. Blanford, directed Mr. Chambers, in April 1887, to take up the investigation of the cyclones of recent years in the Arabian Sea and to submit a report before the end of the year 1887. In accordance with this order Mr. Chambers forwarded, on the 27th December 1887, the report on the cyclone of May 1881 in the Arabian Sea. After a reference to

the Government of India, it was sent to press, and will be ready for issue during this year.

BAROMETERS.

A question which has come prominently before me whilst doing the daily report work, has been the very doubtful and unsatisfactory character of the barometric observations submitted by many stations. The necessity for the greatest possible accuracy in this element of observation is obvious to any one who has thoroughly realized the extreme smallness of many of the more important barometric indications in India. The reasons for this have been already stated—*vide* pages 4 and 5.

Amongst the more remarkable cases of frequent or lengthened erroneous barometric observations which have come to my notice during the past year I may mention—

(1) Gya.	(4) Rangoon.	(7) Cuddapah.
(2) Rawalpindi.	(5) Moulmein.	(8) Madura.
(3) Thayetmyo.	(6) Bangalore.	(9) Roorkee.
	(10) Pachpadra.	

It may be premised that when the reduced observations at any station, as published in the daily report, differ very considerably from those of all neighbouring stations, if they do not represent local stormy weather at or near that station, they are almost certainly erroneous. Such erroneous observations sometimes continue for weeks or even months, and may be due to prolonged careless and inaccurate reading of the barometer, or to ignorance of the proper method of reading the instrument or indolence in not adjusting the instrument correctly before reading it, or to imperfections of the instrument which are either not noticed or are ignored by the observer, or, finally, to the inaccurate determination of the height of the barometer above the sea-level. The majority of the stations named above I visited myself, in order to ascertain whether the inferences drawn from the daily report work as to the character of the barometric observations of these stations were correct or not.

In the case of Gya, there is some doubt about the elevation which is under investigation. But the greater part of the discrepancy in the observations of previous years has undoubtedly been due to careless observations, and in part to the employment of an erroneous correction for the index-error of the instrument in use during the past year. The means based on the observations of previous years can hence not be relied on as accurate or useful for comparison.

When I visited Thayetmyo, the regular observer was absent on leave, and I was hence unable to ascertain the error so far as it depended on the observer. The barometer was a good one and in satisfactory condition. Erroneous readings continued to be submitted, and it was only after I had fined the observer on several occasions for inaccurate observations that the cause was ascertained. They were simply due to the Assistant Surgeon, who is the observer, handing over the duty of taking the observations, for which he was paid, to the Compounder, and the latter was careless in doing what was not his duty. There is of course no objection to an observer teaching any one to record the observations and allowing him to take them occasionally, as it has the advantage of providing a substitute in case of illness of the observer, &c., but the observer should assure himself that the observations thus taken are correct.

A similar arrangement between the Assistant Surgeon and Compounder was recently found to obtain at Rawalpindi, and explains many of the anomalous results which have been submitted from that station during recent years.

The cause of the erroneous readings at Cuddapah was quite different. The barometer was a Kew-principle instrument, and extremely sluggish in its action. I took a long series of comparative readings on my visit to that station, and found that its error to the Calcutta standard in a single day varied from '02" to '09". This explained fully the cause of the erroneous barometric observations which had been submitted for many months from Cuddapah, and to which I had directed the attention of the Superintendent of the Observatory and the Meteorological Reporter, Madras; but without obtaining any clue to the cause. I left one of my secondary standards there, in order that accurate observations might be begun without the delay and risk of forwarding an instrument from Calcutta. In less than two months this instrument was injured so as to unfit it for further use by some mischievous person, and the observer and Superintendent have been unable to ascertain how or by whom it was broken. The barometric observations taken for some time at Cuddapah have been hence utterly untrustworthy, and the monthly means published in the annual report of little or no value.

At Bangalore I found that the observer (drawing R40 per mensem) was careless in his work, and that the barometer was a very unsatisfactory instrument. Its error, as determined some years ago, was '044". When Mr. Blanford visited the observatory in 1886, he found the error to be '079". I took a series of 24 comparative readings with two secondary standards, and found the error to be '056". I did not think it necessary to make a longer comparison, as a barometer with a large and very variable error, such as that of the Bangalore barometer, is utterly useless for the exact barometric observation necessary in India, and should be at once rejected. As at Cuddapah, I left one of my secondary standards. The observations have been more satisfactory, although there is still an apparent excess in the readings reduced to sea-level, which may perhaps be due to the imperfections of the formula employed in India for the reduction of barometric readings to the sea-level or to the peculiar position of Bangalore with respect to the neighbouring hills.

At Madura the mercury in the cistern was coated with so thick a crust of oxidized mercury that it was impossible to read the instrument correctly. The observer's readings and mine differed by very variable amounts. The instrument was in this case also condemned, and another has been sent from Calcutta to replace it.

Similarly, at the remaining stations, almost without exception, the inaccurate observations were found to be due either to instrumental defects or to carelessness of the observer. Thus at Rangoon it was entirely due to the latter. The observer shirked his work, and deputed it to the second observer, who was only paid to assist in taking hourly observations on four days of the month, with the inevitable result that the observations were quite unreliable.

At Moulmein there was some air in the tube, the presence of which the observer was unable to detect.

At Pachpadra the errors during the latter part of the year were very large, and were ascertained by the Superintendent, after the observer's pay had been suspended, to be due entirely to the carelessness of the observer in not carrying out the instructions

contained in the *Vade Mecum*. The surface of the mercury had not been adjusted to the fiducial point for months, and was stated to be about a quarter of an inch below its proper level. The barometric observations taken in 1887 at that station are hence utterly worthless, and the means of previous years probably unreliable.

At Roorkee the apparently erroneous observations were found after a long enquiry to be due to a change of barometer, the notice of which was sent to Simla, but apparently never reached the Simla Office. It was only by continued insistence on the inaccuracy of the Roorkee reduced readings by the Simla Office, and after much correspondence with the Reporter for the North-Western Provinces that the cause of the error was finally discovered by the Calcutta Office.

Finally, several of the Bombay stations are provided with Adie's small mountain barometers which hang freely. These appear to be utterly unsuited for accurate work. They are difficult to adjust, and are liable to unknown errors, as the observers, in order to adjust them, occasionally take hold of the cistern to steady the instrument, and hence heat the mercury in the cistern and thus affect the readings. Mr. Chambers has, however, a high opinion of their accuracy, and his observers have now become accustomed to them. I have not therefore thought it desirable to change them, but the use of such instruments in my opinion makes many of the Bombay barometric observations less satisfactory than they would be, if the observers had been originally provided with really accurate instruments.

It is hence almost certain that barometric work, especially in Southern India, is not as satisfactory as it ought to be, and that the preparation of the daily chart enables the Simla Office generally to detect large or long continued errors. It is probably quite up to the average of European work, but in India much greater accuracy is essential.

Hence it is very desirable that—

- 1st—The same type of instrument should, as far as possible, be used over the whole of India, so that errors due to the comparison of observations taken by different classes of instruments should be eliminated.
- 2nd—That the instrument should be one, the error of which is small, and not liable to large or sudden changes of error.
- 3rd—That more frequent inspection and careful comparison of barometers as soon as their readings become suspicious should be made.
- 4th—That any instrument the error of which has altered in a large or variable manner should be at once rejected.
- 5th—That all observations which are *prima facie* probably wrong should be rejected, and if further evidence and examination confirm this judgment, the observer should be fined for taking inaccurate observations.

Perhaps by attention to these points it may be possible to raise the standard of barometric observations over India to the highest level of accuracy.

The question of the best form of instrument for use in our Indian observatories has not yet been fully considered. I hope shortly to arrange for annual or biennial meetings of the Reporters to consider what improvements can be effected either in instruments or in the work of the Department from time to time. If this suggestion be carried out, one of the first questions which I propose to take up is the type of barometer best suited for our Indian observatories.

MARINE WORKS.

No extension has been made in this work during the year. The following gives a statement of what has been done:—

1st.—208 logs relating to the Bay of Bengal were collected by the Calcutta Office.

2nd.—98 logs relating to Arabian Sea were collected by the Bombay and Calcutta Offices.

In addition to this, the Hon'ble Ralph Abercrombie has taken up the question of the relation of the south-west monsoon to the south-east trades, and suggested the collection of cloud observations near the equator in the Indian Ocean. I have endeavoured to obtain the co-operation of seamen on this point.

ACTINOMETRIC OBSERVATIONS.

The actinometric work has been continued at Mussooree during the past year under the general superintendence of Colonel Haig, R.E., Deputy Surveyor General, in charge, Trigonometrical Branch, Survey of India. These observations are chiefly taken in order to supply observations of a special nature for measuring the intensity of solar radiation to the Solar Physics Committee in England. They are forwarded in full to the Committee at regular intervals. No information has been received as to whether the observations are being utilized. It is very doubtful whether they are of any real value for the object aimed at. The amount of cloud is very large at Mussooree during the last seven or eight months of the year (or during a considerable portion of the cold weather and nearly the whole of the rains), whilst in the hot weather the sky and sun are frequently more or less obscured by dust haze. The question of the abolition or reduction of this observatory will probably be considered during the present year.

The following gives an abstract of the actual amount of actinometric work performed at Mussooree during the year:—

MONTHS.		DAILY SERIES.	
		Complete.	Incomplete.
April	1887	1	16
May	„	0	2
June	„	0	5
July	„	0	0
August	„	0	0
September	„	0	2
October	„	8	13
November	„	18	3
December	„	4	14
January	1888	8	2
February	„	0	6
March	„	8	7

INFLUENCE OF FORESTS ON RAINFALL, &C.

In conjunction with the Forest Department, the question of the influence of forests on rainfall continues to form an object of enquiry. Meteorological observations have been taken for the past three years in the Ajmere Forests, and sanction has been granted to their continuance for another two years, when the whole of the observations taken during the five years will be discussed and utilized, to ascertain how far the growth of forest influences the meteorological elements of humidity, temperature, and rainfall in that part of India.

A different method has been introduced in the Saharanpore Forest Division during the year. The object aimed at there is to ascertain the effects of fire conservancy on the *raos* of that Forest Division. Twelve representative *raos* between the Ganges and Jumna Rivers have been selected for purposes of observation by the Inspector General of Forests and Conservator of the School Circle, and in each Forest Chowkie a rain-gauge is suitably placed. Five of them are located in the forest of Sakranda, which is neither closed to grazing nor protected from fire. The rainfall measurements will be made by the forest guards, and the returns submitted to the Meteorological Department for critical examination. These observations will probably give a valuable series of data for testing the effect of different forest conditions in modifying the amount of rainfall, and hence also probably throw some light on the general question of the influence of afforestation on rainfall.

ESTABLISHMENT OF EXTRA INDIAN OBSERVATORIES.

One extension which the Department has kept steadily in view for some time is the establishment of observatories in the large area lying between Europe and Northern India, including Afghanistan, Baluchistan, Persia, Arabia and Asiatic Turkey. A number of observatories in these countries suitably located would, if trustworthy observations could be secured, enable the meteorology of India to be linked on to that of Europe. Such an addition would perhaps enable meteorologists to trace the further course of those storms which pass across Central and Southern Europe, and thence disappear in Asia. Observatories have been established, and are in full working order at Quetta in Baluchistan, Bushire in Persia, and Aden in Arabia, and an observatory was opened at Baghdad during the year. The English Meteorological Council have urged the establishment of an observatory at Perim, in order to provide information with regard to weather conditions and currents at the entrance of the Red Sea, which it wishes to embody in a series of charts it is preparing for the use of sailors navigating that sea. The question is now before the Government of India. A supply of instruments has been sent to Meshed on the Perso-Afghan Frontier, and a valuable series of observations will probably be taken in a region of which little or nothing is known. Instruments have also been sent to the Medical Officer, Khar, in Eastern Baluchistan, at the request of the Punjab Government.

SNOWFALL REPORTS AND FORECAST OF THE GENERAL CHARACTER OF THE SOUTH-WEST MONSOON RAINFALL.

Mr. Blanford, some years ago, investigated the influence of heavy snowfall during the winter in the North-Western Himalayas and Afghan mountains upon the rainfall of the succeeding south-west monsoon period. He gave numerous examples which appeared to

establish that heavy winter and spring snowfall has, during the past ten years, been usually followed by a retarded monsoon in Upper India, and also generally by scanty monsoon rainfall in that area. The relation thus apparently established was one of considerable importance practically, as it enabled the department to a certain extent to ascertain the existence of conditions previous to a partial or complete failure of the rains in Upper India, which is one of the areas in India peculiarly liable to drought and famine, and hence to forecast the occurrence of drought and therefore of famine. Mr. Blanford, with this object in view, established a system of snowfall reports which, although confessedly imperfect, appear to give a fairly accurate view of the general character of the winter Himalayan snowfall. A *resumé* of these has been published annually (since 1885) by Mr. Blanford, and the most important deductions respecting the probable character of the succeeding south-west monsoon rainfall stated.

The problem of forecasting in May or June the character of the approaching south-west monsoon is one of great interest and of still greater practical utility. The materials at the disposal of the meteorologist in working out the problem are confessedly imperfect. The rainfall of the south-west monsoon occurs chiefly in India, Burma and the neighbouring area of the Indo-Chinese Peninsula, and is due to the advance of a moist current from the Indian Ocean to these areas. The change in India is a comparatively abrupt one. It is not like the hot season, in which, with certain oscillatory features, the leading conditions are slowly established. It is an abrupt transition marked by the rapid advance of an air current of different and opposite characteristics from that which it displaces.

As I have pointed out on more than one occasion, there are probably three main causes which determine the intensity and area of extension of the monsoon current and the distribution of the accompanying rainfall. The first is the conditions over the sea area whence the lower current proceeds, and acquires the vast amount of moisture, the larger proportion of which is precipitated in India. The second is the conditions or abnormal features in the land areas of India, Burma, &c., towards which the current advances, and over which the ascensional movement necessary for precipitation takes place in an irregular and diffused manner, and gives rise to the general, fairly continuous, and widely-spread rainfall which occurs during the greater part of the south-west monsoon period. The third is the existence of any abnormal features prevailing to the north of India, and more especially over that large and wide belt or area of entirely different conditions from those which prevail in India itself, *viz.*, the Himalayan mountain and snow region, which virtually extends over a length of 1,750 miles, and an average breadth of at least 200 miles. That the third cause does exercise occasionally a powerful effect has been sufficiently established by Mr. Blanford. That the second cause, *viz.*, local variations or abnormal conditions, chiefly indicated by persistent pressure peculiarities, does also exercise a powerful influence in determining the distribution of the south-west monsoon rainfall, has been shewn more or less fully both by Mr. Blanford and myself in the annual reports and in occasional publications of the Meteorological Department. The first cause of variation is undoubtedly quite as effective as the others, although the evidence is as yet very limited, and it is that for which it is most difficult to collect systematic and reliable observations. An attempt has been made for some time to collect data for the Bay of Bengal. No systematic effort has as yet been made at Bombay to collect observations from ships traversing the Arabian Sea.

Hence as there are as yet no available means of ascertaining the actual variations over the sea area which are effective in modifying the strength and character of the monsoon rainfall, the Indian Meteorologist is necessarily obliged to rely only upon his land data. They are confessedly imperfect, but they are all that he possesses, and until he learns how to use the exact data furnished by the land observatories, he will be unable to interpret the more uncertain indications that would be afforded by meteorological observations in the Indian Ocean, even if they could be placed early enough at his disposal to be utilized in forecasting the character of the south-west monsoon.

Hence in publishing the summary of the winter snowfall and the monsoon forecast hitherto based chiefly upon it, I utilized both the second and third methods as fully as the data appeared to warrant, and based on them the following forecast in the first week of June 1887 :—

“ The chief inference of the character of the approaching monsoon deduced from the present and previous meteorological conditions are as follows :—

- (1) The general indications are favourable in North-East and North India and somewhat unfavourable in Southern India.
- (2) The Bay of Bengal monsoon current will probably be stronger than usual, and give early and abundant rainfall to Northern India, and more especially in Upper India.
- (3) The Bombay monsoon current will probably be retarded and perhaps be feebler than usual. It will be late in being established on the Bombay coast, and there is a strong probability that the rains will be more or less deficient in the Poona, Sholapur, Belgaum, and adjacent districts.
- (4) Indications are especially favourable to abundant rain in the Punjab and to a less extent in the Central Provinces, and hence it is probable that the high pressure in the Bombay coast districts will be much less influential than in 1876-77, and that it will not do more than slightly retard the Bombay monsoon and diminish the rainfall in the districts above mentioned.”

The forecast was in general agreement with the actual character of the monsoon. The south-west monsoon gave, on the whole, abundant rain to Northern India, and more especially to the Central Provinces and to the greater part of the South-East Punjab, East Rajputana, and the western districts of the North-Western Provinces. The rains held off to a certain extent in the Punjab in July, but this was not due to the absence of favourable conditions in the Punjab itself, but to weakness in the two currents, more especially the Bombay current.

The Bombay monsoon current was weak at its commencement and was somewhat later than usual in being fully established on the West Coast. There was an excessive determination of rain to the Central Provinces which received an average of 58·46 inches from 1st June to 30th September, or 12·22 inches more than the normal average of the period.

There was a slight or moderate deficiency during the monsoon months of June, July, August and September over a portion of the Bombay-Deccan represented by Poona and Sholapur, but it was of no great importance, and the whole of the Deccan received favourable rain in October and November.

The following table of the monsoon rainfall of 1887 shows the general character of the distribution of the south-west monsoon rainfall of the past year, and it will be seen that the forecast was in fair accordance with it :—

		June.	July.	August.	September.	Total June to September.
		Inches.	Inches.	Inches.	Inches.	Inches.
PUNJAB PLAINS	Actual, 1887	1'26	5'38	9'71	2'43	18'78
	Difference from normal	—0'83	—0'97	+4'40	0	+2'60
N.-W. PROVINCES AND OUDH.	Actual, 1887	3'66	11'96	15'57	6'05	37'24
	Difference from normal	—1'06	+0'23	+5'45	—0'35	+4'27
GUZERAT	Actual, 1887	6'72	16'66	6'06	1'67	31'11
	Difference from normal	+2'19	+3'74	—2'31	—4'24	—0'62
NORTH BEHAR	Actual, 1887	11'52	7'52	12'79	7'48	39'31
	Difference from normal	+3'01	—5'17	+1'27	—2'52	—3'41
SOUTH BEHAR AND CHUTIA NAGPUR.	Actual, 1887	5'45	11'21	10'70	6'37	33'73
	Difference from normal	—2'16	—1'50	—1'67	—2'14	—7'47
NORTH BENGAL	Actual, 1887	23'90	9'13	13'74	12'01	58'78
	Difference from normal	+6'69	—5'32	—0'43	—1'66	—0'72
SOUTH-WEST BENGAL	Actual, 1887	8'34	12'34	9'86	8'02	38'56
	Difference from normal	—1'86	+0'39	—3'07	—1'11	—5'65
CENTRAL PROVINCES	Actual, 1887	9'20	23'58	17'54	8'14	58'46
	Difference from normal	+0'17	+7'12	+5'31	—0'38	+12'22
KONKAN AND GHATS	Actual, 1887	44'32	57'07	26'91	19'00	147'30
	Difference from normal	+11'18	+4'77	—5'97	+0'12	+10'10
BOMBAY-DECCAN	Actual, 1887	4'83	8'28	3'47	4'51	21'09
	Difference from normal	—0'24	+2'01	—1'24	+0'06	+0'59
HYDERABAD	Actual, 1887	5'53	6'62	8'72	6'50	27'17
	Difference from normal	+0'31	—0'33	+1'37	—0'26	+1'09
CEDED DISTRICTS AND MYSORE.	Actual, 1887	3'88	3'12	5'60	4'96	17'56
	Difference from normal	+0'82	—0'42	+1'20	+0'17	+1'77
CARNATIC	Actual, 1887	2'72	1'34	4'32	3'85	12'23
	Difference from normal	+0'88	—1'02	+0'25	—0'34	—0'32

PART II.—DETAILS OF ADMINISTRATION.

OBSERVATORIES.

At the commencement of the year under report, there were 135 observatories in India and elsewhere, contributing original registers to the Central Office. A new observatory was opened during the year at Baghdad in Asiatic Turkey. The Dehra (Forest School) and Baroda observatories did not contribute any registers during the year. Thus, at the close of the year, there were 134 observatories working in connection with the department. These are enumerated in the following list, which also specifies the class to which they belong. The classes are:—

1st Class, furnished with autographic instruments for pressure, temperature, humidity, rainfall and wind registration, either continuously or at 10 minutes' intervals.

2nd Class, at which hourly observations are recorded on four days in each month and on other days observations are either taken three times or four times during the day. Certain of these observatories are furnished with anemographs for the continuous registration of the wind.

3rd Class, at which observations of pressure, temperature, &c., are recorded twice daily, *viz.*, at 10 A.M. and 4 P.M., and measurement of rainfall is taken at 6 P.M. Certain of these observatories are also provided with anemographs, and also recorded during the greater part of the year an additional set of observations at the local time corresponding to 6 h. 52 m. Washington time. These observations were transmitted to the United States for inclusion in the series of international or synoptic observations published by the Washington Weather Bureau.

4th Class, at which observations of temperature, wind, and rainfall only are recorded.

BENGAL AND ASSAM.

	Class.		Class.		Class.
Calcutta (Alipore)	1st	Chittagong	3rd	False Point	3rd
Dhubri	2nd	Darjeeling	"	Pedong	"
Saugor Island	"	Purneah	"	Calcutta (Chowrin-	
Tezpur	3rd	Durbhunga	"	ghee)	4th
Sibsagar	"	Gya	"	Demagiri	"
Silchar	"	Berhampore	"	Mongpoo	"
Bankipore (Patna)	"	Burdwan	"	Tura	"
Hazaribagh	"	Jessore	"		
Cuttack	"	Dacca	"		

NORTH-WESTERN PROVINCES AND OUDH.

	Class.		Class.		Class.
Allahabad	1st	Chakrata	3rd	Gorakhpur	3rd
Mussooree (Surveyor- Genl.'s office)	2nd	Ranikhet	"	Ghazipur	"
Agra	3rd	Dehra (Surveyor-Genl.'s office)	"	Benares	"
Lucknow	"	Bareilly	"	Jhansi	"
Roorkee	"	Meerut	"	Pithoragarh	"

PUNJAB.

	Class.		Class.		Class.
Lahore . . .	2nd	Murree . . .	3rd	Kailang . . .	3rd
Mooltan . . .	3rd	Sialkot . . .	"	Delhi . . .	"
Dera Ismail Khan . . .	"	Ludhiana . . .	"	Sirsa . . .	"
Peshawar . . .	"	Chamba . . .	"		
Rawalpindi . . .	"	Simla . . .	"		

CENTRAL PROVINCES.

	Class.		Class.		Class.
Nagpur . . .	2nd	Hoshangabad . . .	3rd	Sironcha . . .	3rd
Jubbulpore . . .	"	Seoni . . .	"	Raipur . . .	"
Pachmarhi . . .	3rd	Khandwa . . .	"	Sambalpur . . .	"
Saugor . . .	"	Chanda . . .	"		

BERAR.

	Class.		Class.		Class.
Akola . . .	3rd	Chikalda . . .	3rd	Makhla . . .	4th
Buldana . . .	"	Amraoti . . .	"		

CENTRAL INDIA AND RAJPUTANA.

	Class.		Class.		Class.
Jeypore . . .	1st	Indore . . .	3rd	Sambhar . . .	3rd
Sutna . . .	3rd	Mount Abu . . .	"	Bickaneer . . .	"
Nowgong . . .	"	Pachpadra . . .	"		
Neemuch . . .	"	Ajmere . . .	"		

BOMBAY.

	Class.		Class.		Class.
Colaba (Bombay) . . .	1st	Jacobabad . . .	3rd	Surat . . .	3rd
Belgaum . . .	2nd	Hyderabad (Sind) . . .	"	Malegaon . . .	"
Poona . . .	"	Bhuj . . .	"	Ratnagiri . . .	"
Deesa . . .	"	Rajkot . . .	"	Karwar . . .	"
Kurrachee . . .	"	Sholapur . . .	"		

MADRAS.

	Class.		Class.		Class.
Vizagapatam . . .	2nd	Kurnool . . .	3rd	Madura . . .	3rd
Bellary . . .	"	Cuddapah . . .	"	Calicut . . .	"
Trichinopoly . . .	"	Madras . . .	"	Wellington . . .	"
Gopalpur . . .	3rd	Bangalore . . .	"	Mercara . . .	"
Cocanada . . .	"	Negapatam . . .	"	Mangalore . . .	"
Masulipatam . . .	"	Salem . . .	"	Rajahmundry . . .	"
Secunderabad . . .	"	Coimbatore . . .	"	Cochin . . .	"

BURMA.

	Class.		Class.		Class.
Rangoon . . .	3rd	Kendat . . .	3rd	Toungoo . . .	3rd
Bassein . . .	"	Bhamo . . .	"	Moulmein . . .	"
Diamond Island . . .	"	Mandalay . . .	"	Mergui . . .	"
Akyab . . .	"	Thayetmyo . . .	"		

BAY ISLANDS.

	Class.		Class.		Class.
Cocos Island . . .	3rd	Port Blair . . .	3rd	Nancowry . . .	3rd

EXTRA INDIAN.

	Class.		Class.		Class.
Aden . . .	2nd	Baghdad . . .	3rd	Katmandu . . .	3rd
Leh . . .	"	Bushire . . .	"	Amini Divi (Lakha-	
		Quett . . .	"	dives) . . .	"

OBSERVATORIES IN BENGAL AND ASSAM.—*The Alipore Observatory.*—This observatory serves as a general dépôt for the verification of instruments, as well as for observations of an experimental character. An important part of its work is the dropping of two time balls at 1 P.M. local mean time for the port of Calcutta. It is immediately superintended by the Reporter to the Government of India, and the establishment is under the charge of the Chief Observer, Babu Brojo Mohun Ruckhit, B.A. The work of the observatory has been fully described in previous Administration Reports (*vide* Report for 1886-87, page 18) and need not be repeated. No change has been made in the establishment of the observatory during the past year.

The autographic instruments consist of a Sunshine recorder, a Kew barograph and thermograph, a Beckley's anemograph, an Osler's anemometer and a Beckley's rain-gauge. During the past year, with but slight exceptions, the instruments have worked well. The interruptions of the photographic records were fewer in number than last year and were all of short duration, rarely exceeding one or two hours.

The trace measurements of the barograph and thermograph have been compared with the eye-readings of the standard barometer and the wet and dry bulbs in the same manner as last year. The object of the comparison was fully stated in the Administration Reports of 1885-86 (page 19) and 1886-87 (page 18), and need not be repeated. The following gives the mean differences for the past three years, and shews that they are almost constant:—

	1885.	1886.	1887.
Mean difference between standard barometer and barograph during year (<i>i.e.</i> , Standard Barometer minus Barograph)	+ '025"	+ '026"	+ '027"
Mean difference between the dry bulb in the thermometer shed and the dry bulb trace of the thermograph (<i>i.e.</i> , Thermograph minus Shed dry bulb Thermometer) .	+ '4°	+ '5°	+ '6°
Ditto ditto wet bulb	+ '6°	+ '5°	+ '7°

The Sunshine recorder has worked satisfactorily. The observations of ground temperature have been carried on as in previous years.

The number of instruments verified at the Alipore Observatory, during the year ending 31st March 1888, is given below:—

Instruments.	Number.
Barometers	52
Aneroids	15
Dry and wet bulb thermometers	31
Maximum thermometers for air temperature	6
Minimum do. do. do.	21
Do. do. for nocturnal radiation	10
Solar radiation thermometers	20
Carried over	155

Instruments.										Number.
										Brought forward . 155
Boiling point thermometers	.	.	.	.	.	.	.	.	.	2
Sling do.	.	.	.	.	.	.	.	.	.	3
Standard do.	.	.	.	.	.	.	.	.	.	8
Common do.	.	.	.	.	.	.	.	.	.	1
Traveller's maximum and minimum thermometers in pairs	.	.	.	.	.	.	.	.	.	1
Rain-gauges	.	.	.	.	.	.	.	.	.	2
Measure-glasses for rain-gauges	.	.	.	.	.	.	.	.	.	2
										<u>TOTAL . 174</u>

The following is a return of the instruments received and issued by the Alipore observatory during the past year:—

INSTRUMENTS.										Received.	Issued.
Barometers	.	.	.	.	.	.	.	.	.	50	41
Aneroids	.	.	.	.	.	.	.	.	.	10	17
Dry and wet bulb thermometers	.	.	.	.	.	.	.	.	.	47	31
Maximum thermometers for air temperature	.	.	.	.	.	.	.	.	.	5	8
Minimum do. do. do.	.	.	.	.	.	.	.	.	.	42	32
Do. do. for nocturnal radiation	.	.	.	.	.	.	.	.	.	12	15
Solar radiation thermometers	.	.	.	.	.	.	.	.	.	24	4
Standard do.	.	.	.	.	.	.	.	.	.	25	2
Common do.	.	.	.	.	.	.	.	.	.	1	1
Boiling point do.	.	.	.	.	.	.	.	.	.	2	2
Sling do.	.	.	.	.	.	.	.	.	.	1	3
Traveller's maximum and minimum thermometers, in pairs	.	.	.	.	.	.	.	.	.	1	1
Rain-gauges	.	.	.	.	.	.	.	.	.	2	2
Measure-glasses for rain-gauges	.	.	.	.	.	.	.	.	.	2	2
										<u>TOTAL . 224</u>	<u>161</u>

The time signals have worked satisfactorily throughout the year. The two time balls at the Semaphore Tower and on the roof of the Port Commissioners' Office were dropped on all days, Sundays and Holidays inclusive. On the days detailed in the undermentioned list, one time ball only gave signal, the other having either failed altogether or dropped inaccurately or was under repair:—

Dates of failure or repair.	Cause of failure.
26th April 1887	Time Ball at the Port Commissioners' Office failed.
27th " "	Ditto ditto ditto ditto.
From 8th April to 9th May 1887	Ditto ditto ditto under repair.
From 26th May to 5th June 1887	Ditto on the Semaphore Tower, Fort William, under repair.
17th August 1887	Time Ball at the Port Commissioners' Office failed.
4th November 1887	Ditto on the Semaphore Tower, Fort William, dropped late.

OTHER OBSERVATORIES IN BENGAL AND ASSAM.—A list of the observatories reporting to the office of the Imperial Government has been given at page 29. Calcutta (Alipore), Calcutta (Chowringhee), Mongpoo and Pedong are immediately under

the Imperial Office, the remainder under the Meteorological Reporter to the Government of Bengal.

The following extracts from the Administration Report of the Bengal Reporter describe the condition and working of the observatories under his charge :—

“The number of observatories in Bengal and Assam from which returns were received in my office during 1887-88 was 52, arranged as follows:—

1 first class.	21 third class.
2 second class.	28 provincial third class.

“This last figure includes Pooree, which was started on 10th August 1887, and which furnished complete observations by telegraph from the 23rd March 1888 for the storm signal service, and also Tavoy, which commenced work on the 20th March 1888.

“INSPECTION OF OBSERVATORIES.—The following stations were inspected during the year:—

By Mr. Eliot, Officiating Meteorological Reporter to the Government of India—

Gya.	Chupra.	Chittagong.	Akyab.
By myself—			
Burdwan.	Durbhunga.	Motiharee.	Dhubri.
Raneegunge.	Bankipore.	Arrah.	Kishnaghur.
	Jalpaiguri.	Darjeeling.	
By my Head Clerk—			
Nya Doomka.	Bankoora.	Dacca.	Furreedpore.
Raneegunge.	Purneah.	Burrisal.	Rangoon.
Bhagalpur.	Maldah.	Noakholly.	Bassein.
Burdwan.	Midnapore.	Comillah.	Moulmein
Berhampore.	Jessore.	Mymensingh.	Tavoy.

“DHUBRI was inspected on the 21st March 1888. One of the main objects of the inspection was to arrange for certain extra work to be carried out at that observatory. The condition of the observatory was fairly good. The velocity part of the anemograph was working very freely, the cups revolving with very light winds. The direction part of the instrument was found to work rather heavily, and the actual wind direction of the vane corresponded to the reverse on the dial. The hourly observations, which had hitherto been taken at Dhubri on only four days in the month have been now replaced by hourly observations taken, since 1st April 1888, on three days during each week, and they will be so continued for one year to make up the complete hourly records of Dhubri, and to enable the average values of that station to be deduced with accuracy. The station will, at the conclusion of the year 1888-89, be reduced to third class, with only one observer on the usual allowance.

“SAUGOR ISLAND was not inspected during the year. Mr. Peters, Telegraph Master, continued to be the observer during the whole year, and has furnished very satisfactory returns. The anemograph also worked well, except that the wind-fans became defective and had to be temporarily replaced by fresh ones from a new anemograph lying in the Imperial Office. A new pair of fans is being made to replace the defective fans permanently. The thermometer shed has been repaired.

“AKYAB was visited by Mr. Eliot, Officiating Meteorological Reporter to the Government of India, to decide the question of removing the observatory to a better site, which was necessitated by the erection of a new Telegraph Office building in close proximity to the shed. He states:—

‘No very satisfactory site near the Telegraph Office could be found, but as it is very desirable to retain the observatory at the Telegraph Office, a new position about as far from the new Telegraph Office as the observatory was from the old office was chosen. The anemometer will be continued at the same site, and the staging for that instrument and the wind-vane will be increased to a height of about 36 feet above ground.’

“BANKIPORE was found to be in good order, except that the wind-vane and the anemometer were badly in want of oil, and the anemometer decidedly dirty.

“CHITTAGONG was visited by Mr. Eliot on the 26th November 1887. He found the instruments in satisfactory condition, except the anemometer, which was very dirty, and in a position where it was

hardly possible to get at it easily to clean it. This has since been altered and the instrument thoroughly cleaned.

"DARJEELING was visited by myself on the 28th, 29th and 31st March 1888 to start the new anemograph in a satisfactory manner. It was found that the new Beckley's anemograph (sent on the 1st August 1887 for use at this observatory) had been erected in a very satisfactory manner, and the anemograph house thoroughly repaired. The clock on inspection was found to be working rather slowly and was liable to stop. The latter defect was put right, but the former will take patience to remedy and to make the clock keep exact time. The wind direction part of the instrument was not recording correctly. This was set right. The instrument is now in excellent order. The wind velocity portion of the apparatus is working freely, and the wind direction portion also moves with a slight shift of wind. The traces on the paper are excellent and the instrument should now give very valuable results. The lightning conductor on the anemograph house appears to be in good order.

"PURNEAH was inspected by my head clerk on the 18th and 19th December 1887. He reports:—

'There was no one to take the 16 hours' observations of the barometer on the 18th. The readings of the rest of the instruments were taken by the Jail warder, and not by the observer, in my presence. I found he could not read them to decimals of a degree. The barometer was in order. The anemometer and wind-vane had been shifted to the south-west corner of the jail and were in an unsatisfactory condition and were put right. The rest of the instruments were in good order. It was ascertained that the observer has been in the habit of delegating his duty of recording the readings of the instruments to the Jail Jemadar who could only be expected to do the work in an imperfect manner.' The explanation furnished by the observer for having thus personally neglected to take the observations on the 18th December not having proved to be satisfactory, he was fined half a month's allowance.

"TEZPUR is the worst kept station in Bengal and Assam. Although the observer has had the benefit of an inspection of the observatory by Mr. Dallas in August 1886, the results of the reduction of the readings reported throw great doubts upon their correctness generally. The barometric pressures of Tezpur for the months of January to May 1887, reduced to sea-level, vary to such a very large extent from the corresponding pressure values at Sibsagar and Dhubri, as to show that the observations were incorrectly taken. The wet bulb readings for September and October 1887 had to be rejected as utterly worthless. The observer was warned, and his allowance was suspended from January 1888 till satisfactory readings are received.

"BERHAMPORE, BURDWAN, JESSORE, DURBHUNGA, DACCA AND GYA were all found on inspection to be in excellent order.

"Of the observatories that were not inspected during the year, Silchar, Sibsagar, Hazaribagh, False Point, Gopalpur and Cocanada have worked satisfactorily and sent in accurate returns.

"The Cuttack observatory has improved considerably during the past year.

"PROVINCIAL OBSERVATORIES—The observatories established for the system of the daily provincial reports in Bengal are the following:—

Balasore.	Comillah.	Bankoora.	Arrah.
Midnapore.	Furreedpore.	Jalpaiguri.	Kishnaghur.
Raneegunge.	Mymensingh.	Bhagalpur.	Dehree.
Noakholly.	Rampore Bauleah.	Chupra.	Nya Doomka.
Burrisal.	Dinaegpore.	Motiharee.	Ranchee.
Serajgunj.	Rungpore.	Buxar.	Chybassa.
	Bogra.	Maldah.	

"They do not furnish returns to the India Meteorological Office at all, and the observations taken at these stations (at 10 A.M.) are utilized solely for the information of the Government of Bengal and its district officers.

"Several observatories of this class have been authorized to report daily (from 1st April 1888) the 8 A.M. observations for the Bay of Bengal weather report. They are Balasore, Burrisal, Midnapore, and the recently started observatories of Pooree and Tavoy. With the exception of Pooree and Tavoy, these stations, and the remainder of the provincial observatories having direct telegraphic communication with Calcutta, submit 10 A.M. observations during the south-west monsoon period by means of telegrams for the Bengal provincial daily weather report, and during the winter months

by means of post-card daily. These observations, as well as those sent in from the other stations, are carefully scrutinized and generally charted, and any palpable or gross errors in the observations are, by this means, at once detected and the defaulting observers fined.

"The observer at Rungpore was thus fined six times during the year; those at Balasore, Jalpaguri and Mymensingh five times; at Furreedpore four times, at Burrisal, Midnapore, Motiharee and Ranchee three times, and at Comillah, Noakholly, Rampore Bauleah and Raneegunge twice.

"The best kept observatories, or those which have furnished correct and regular returns throughout the year, and the observers at which have not been subjected to any fine, are Arrah, Buxar, Kishnaghur, Bogra, Chybassa and Chupra. This is creditable both to the observers and to the Superintendents in charge.

"The provincial observatories inspected were—

Arrah.	Chupra.	Kishnaghur.	Mymensingh.
Bankoora.	Comillah.	Maldah.	Noakholly.
Bhagalpur.	Furreedpore.	Midnapore.	Nya Doomka.
Burrisal.	Jalpaguri.	Motiharee.	Raneegunge.

Tavoy.

or 17 out of 28 stations have been visited during the year.

"Of these, Arrah, Burrisal, Chupra, Bhagalpur, Comillah, Furreedpore, Kishnaghur, Motiharee, Mymensingh, Noakholly, Raneegunge were all found to be in good working order.

"JALPAIGURI was in a very unsatisfactory condition, and the observer not competent for his duties. The observatory has since been removed to the compound of the Post Office, and placed under the Postmaster.

"At MALDAH the barometer and anemometer were both out of order, and the condition of the observatory very unsatisfactory. The observer has been repeatedly fined, but with little effect

"MIDNAPORE was visited by my head clerk on the 22nd May 1887. The observer was punctual in attendance, and all the instruments except the barometer were in fair working order. * * The barometer was changed and the observer's defective method of reading the instrument corrected. The Roorkee pattern wind-vane was also out of order; the cardinal points were not fixed, but were found to rotate through a certain angle in their position.

"NYA DOOMKA.—The observer took the observations quickly and correctly, but generally speaking the observatory was not well kept up. The wet bulb thermometer was not properly covered with muslin. This accounts for the small difference (1 to 3 degrees) between the readings of the dry and wet bulb thermometers latterly. The anemometer was sadly in want of oil. It was hence working heavily, and with considerable friction.

"TAVOY, Head-quarter station of Tenasserim, Burma. This observatory was started in March 1888 by my head clerk. The observatory is in the circuit-house compound which has been partly cleared of trees to give a suitable position for the shed. It is therefore in an open place, free from the influence of any building or trees near it. The shed has been very substantially built of wooden posts on the standard plan, but thatched with *dhane* leaves, as straw thatching is not known, and with pallisading enclosure and a gateway, which affords complete safety to the instruments in the shed. The wind-vane and the anemometer have been set up on the top of the Deputy Commissioner's court-house, which is a two-storied wooden building. It is the highest accessible point where the instruments could be exposed. A wooden step ladder has been provided from the District Superintendent of Police's office room to the instruments which have been fixed very strongly by means of iron bolts and nuts. The barometer has been suspended in good light in the signal room of the Telegraph Office, which is also a two-storied wooden building quite close to the court-house and the thermometer shed. The rain-gauge is placed near the shed, and far off from the influence of any trees. The exposure of the several instruments is as good as possible under the conditions of Tavoy. But the wind observations from the position and nature of the station cannot be very accurate or indicative of the actual wind direction and force on the sea-face. The Telegraph Master, who is quick and intelligent, has been thoroughly trained for the duties of observer, and the observatory began to telegraph full observations from the 20th March 1888.

"Anemographs.—The self-recording anemographs have been at work as hitherto at the stations of Dhubri, Hazaribagh, Cuttack, Chittagong, Saugor Island and Darjeeling. At the first three stations

Cassella pattern instruments are still in use, and at the fourth, fifth and sixth Beckley's instruments. The records from Hazaribagh are fairly complete, but those of Cuttack are very imperfect. The embossed arrows showing the wind direction were very indistinct on several days, and some of the records had to be rejected on this account. The anemograph at Chittagong worked very well during the year except from October 23rd at 8 P.M., up to the 25th at 9 A.M., when the instrument was being cleaned. At Darjeeling the old Beckley's anemograph ceased to work from September 1887, the bed plate having become warped, rendering the instrument useless, as the registering part ceased to act. A new Beckley's anemograph of larger pattern was supplied and was put up in position by the Public Works Department in a satisfactory manner. It began to work from 27th March, but the first workable and complete traces of the instrument date from 5th April 1888."

OBSERVATORIES IN THE NORTH-WESTERN PROVINCES AND OUDH.—A list of the observatories has been given at page 29. Mussooree is immediately under the Imperial Office, and the remainder under the Meteorological Reporter to the Government of the North-Western Provinces and Oudh.

The work of the first class observatory at Allahabad was fully described in last year's Administration Report, and is not repeated, as no change was made during the year. The new observatory buildings accommodate the Meteorological Reporter's Office, as well as the observatory establishment.

The following extracts from Mr. Hill's Administration Report for the past year give the most important facts respecting the working and inspection of the observatories in the North-Western Provinces and Oudh during the year :—

"**JEYPORE.**—This observatory, maintained at the cost of the Maharajah of Jeypore, was under the superintendence of Dr. Hendley for the whole twelve months. It continued to work in its usual efficient manner. The Superintendent has published a report in which it is stated that in addition to the regular observations of the ordinary instruments made four times daily, and also every hour on four days each month, a nearly continuous record is furnished by a Van Rysselberghe meteorograph, and an Osler anemometer. There is also at this station an autographic record of sunshine, and there are records kept of earth temperatures at various depths down to 40 feet, as well as of cloud movements as shown by the nephoscope. Dr. Hendley's report also shows that useful records of rainfall and temperature are now made at numerous dispensaries scattered all over the Jeypore territory.

"**ALLAHABAD OBSERVATORY.**—The self-recording meteorograph of the Allahabad observatory, which was sent to the maker for repairs at the beginning of the year, was only returned a short time ago, and has not yet been set up again. Throughout the year the usual observations were made by eye four times each day, and hourly observations of temperature, humidity, cloud, rain, wind-direction and velocity were made twice a week. The experience of the twelve months shows that hourly observations of all the meteorological elements usually observed might be carried on continuously at less cost than an autographic record can be obtained by the Van Rysselberghe apparatus. The results would also be probably more exact, and the tabulations and reductions could be effected by the observers from day to day. The introduction of costly autographic instruments of delicate and complicated construction into this country of cheap clerical labour seems, therefore, to be a matter of doubtful expediency. The Tower observations of temperature and humidity mentioned in last year's report are still continued, and a part of the saving accruing from the disuse of the meteorograph has been devoted to carrying out similar observations at two greater heights on the Muir College Tower.

"The Sunshine recorder worked continuously, with the exception of two days in June.

"Earth temperature observations at various depths down to nine feet were made as in the previous year, and transmitted every month to the Calcutta Office for publication in the annual meteorological report. The movements of the upper clouds were also noted when such clouds were visible.

"*Third class observatories.*—The remaining observatories, which now all rank in the third class, that is to say, at which, as a rule, only two regular sets of observations are taken daily, continued to work as usual, though in some respects their working was less satisfactory than in former years,

Those at Lucknow, Bareilly, Ranikhet and Pithoragarh were inspected by me in the summer vacation; those at Sutna and Benares in August and September respectively, and those at Jhansi and Nowgong in the Christmas vacation. Mr. Eliot also inspected the observatories at Sambhar and Ajmere. Of the nineteen observatories reporting to my office, therefore, only six were unvisited by an officer of the Meteorological Department during the year; *viz.*, those at Chakrata, Dehra, Meerut, Agra, Gorakhpur and Ghazipur; and of these six the three at Dehra, Meerut and Ghazipur are voluntary or independent institutions.

"At the time of inspection the observatory buildings, instruments, books and papers were, as a rule, found in good order, and most of the observers appeared to be efficient, attentive and punctual.

"At Jhansi, the instruments were moved with the dispensary on the 14th June to a temporary location at the Rani's Gardens in the city, where the exposure of the thermometers and rain-gauge is not as good as could be desired, but no better site was at the time available. In setting up the wind-vane on the roof of the palace, a mistake of two points was made in orientation, and this continued until the time of my visit in December. I found also that the nominal observer was not in practice the actual observer, and that he could not read the barometer correctly. On my representing this to the Superintendent, Compounder Ashraf Ali, who had been actually taking the observations for some time, was appointed as regular observer.

"At Ranikhet, the thermometer shed was found in bad repair, but that has since been remedied. The anemometer was worn out and had to be replaced by a new instrument. The observer, Jewa Nand, for a long time sent in returns in which the readings of the nocturnal radiation thermometer were absurdly low, the instrument being evidently out of order, and for this his special good-service allowance of Rs. 10 per month was stopped from September to the end of March.

"The observer at Bareilly, Sunder Lal, was dismissed in December for the insolent manner in which he protested against the infliction of a fine for sending in erroneous readings of the minimum thermometer. The instrument had got broken by some accident, and, in consequence of the loss of some of the spirit, its readings were erroneous to the extent of upwards of 20° for upwards of a month. But the observer never noticed the error nor reported it. Small fines were inflicted on the observers at Gorakhpur, Chakrata and Ajmere."

OBSERVATORIES IN THE PUNJAB.—The observatories in this province are the same in number and position as in the previous year, and are enumerated on page 30. Chamba and Kailang are immediately under the Imperial Office and the remainder under the Meteorological Reporter for the Punjab.

The following extracts from the Administration Report of the Punjab Reporter give briefly the chief facts of the condition and working of these observatories.

"At Lahore the Superintendship of the observatory has changed hands, Mr. J. C. Oman having proceeded on long furlough. He was succeeded by Dr. Dickson, Superintendent of the Central Jail, who carried on the duties from 11th April 1887 till the close of the official year.

"Observations of the sun and grass radiation thermometers have been discontinued from 1st January 1888 at all the Punjab stations, except Rawalpindi, Murree, Lahore and Simla.

"The synoptic observations undertaken at Lahore for the United States Government have also been discontinued.

"The following observatories were inspected during the year:—

Mooltan.	Ráwalpindi.	Simla.
Dera Ismail Khan.	Siálkot.	Delhi.
Pesháwar.	Lahore.	Sirsa.

The first five stations were inspected by Babú Jaspat Rái, Head Clerk and Chief Observer at the Lahore Observatory, the last four by myself.

"Of Mooltan there is little or nothing to say. Dera Ismail Khan, as on the occasion of my own visit in the previous cold weather, was not in a satisfactory condition. The instruments again showed that proper care and attention were not given to them. Pesháwar at the time of inspection was, as it has always been found, in exceedingly good order. Large buildings are, however, being erected in

the neighbourhood of the observatory;—changes which may perhaps seriously affect the temperature and wind observations.

“At Ráwalpindi the barometer was out of order, and since the visit of the Inspector this instrument has been replaced by another sent from Calcutta. The pressure observations from this station have long been peculiar, but whether this result is due to defective instruments, as was the case at the time of inspection, or to other causes, has not been ascertained.

“At Siálkot and Lahore the condition of the observatories was quite satisfactory.

“At Simla there has been no change in the site of the observatory. The shed is on the southern slope of a hill, and is exposed to a large amount of radiation from surrounding objects, walls, &c., hence the temperature observations and means are higher than would be anticipated. Also, owing to the unfavourable position of the observatory, it is not possible to expose an anemometer under anything approaching favourable conditions, so that no estimate of the wind force is received from that station.

“At Delhi and Sirsa there has been no change with respect to the observatories.

“At the request of Dr. Alcock and the Deputy Commissioner of the Deraját Division, meteorological instruments have been sent to the Trans-Indus stations of Khar, Rukni and Kingri. Returns from these stations have not yet been received, but it is hoped that these frontier observations will help to throw light on the obscure problem of the formation and advance of the cold-weather storms on which the agriculture of the Punjab so much depends.

“At Lahore, two of the self-registering instruments, *viz.*, the rain-gauge and the sun thermometer, are now in position, and both are working satisfactorily. The other instruments have been received in Calcutta and are about to be forwarded to Lahore. The work of setting up these instruments has devolved on the Superintendent of the observatory, Dr. W. P. Dickson, and it is due to his care that satisfactory results have already been obtained. The exposure of the dry and wet bulb thermometers will require some structural alterations in the observatory building, but I hope these will be carried out at small cost, and when completed the Lahore observatory will be raised to the first class, and continuous records of all the meteorological elements will be registered there. In consultation with Mr. Hilton, Executive Engineer, general details of the anemometer tower have been decided on, and the work will shortly be commenced.

“The inspections carried out by Bábu Jaspat Rái were very carefully performed, and his notes on the condition of the observatories and instruments show that he has carried out this duty in a thorough and pains-taking manner.”

OBSERVATORIES IN THE CENTRAL PROVINCES.—The observatories, enumerated on page 30, remained the same as in 1886-87, but that at Sironcha, which had been closed from the 8th November 1886, was, on the return of the observer from leave, re-opened on the 8th April 1887. The observatory at Pachmarhi was reduced from the 2nd to the 3rd class from 15th May 1887.

All these send their registers to the Imperial Office.

During the year the Sanitary Commissioner inspected the observatories at the following stations:—

Nagpur.	Seoni.	Hoshangabad.
Pachmarhi.	Khandwa.	Sambalpur.
Jubbulpore.	Raipur.	Saugor.

The following brief extracts are taken from the inspection report of the Sanitary Commissioner:—

“SAUGOR.—The barometer has been shifted during the year to a masonry building originally used as a sentry box. The instruments were all in good order. New railings have been put up round the observatory shed, and the rain-gauge and grass radiation thermometers exposed in more suitable places.

“KHANDWA.—The shed and barometer house were in good repair, and the instruments clean and in good order. The observer read correctly.”

"JUBBULPORE was inspected on 31st August. The shed was in good repair. The instruments were in good order and well kept. The wind-vane and anemometer are somewhat sheltered by trees.

"HOSHANGABAD was visited on 4th October. The shed was somewhat out of repair. The instruments were all in good order. The observer can read the instruments correctly but is reported to be lazy.

"PACHMARHI was reduced from a second class to a third class observatory from 15th May. This change was necessitated by the gross carelessness and inaccuracy of the first observer who was dismissed on the reduction of the observatory, and the second observer appointed to be permanent observer. The shed was found to be in good repair. The barometer is placed in the Record-room of the Kutcherry, to which there is general access and is hence liable to interference and injury. The anemometer was not rigidly fixed, and hence vibrated very much in high winds.

"SEONI, RAIPUR and SAMBALPUR were found to be in efficient working order, and the instruments clean and in satisfactory condition.

"The observatories at Chanda and Sironcha were not inspected during the year. The observations submitted, with the exception of the barometric readings at Chanda, harmonized with those of neighbouring stations and hence were satisfactory."

Nagpur was inspected by myself in February 1888. The situation of the observatory and exposure of the instruments are satisfactory. The barometer is in good working order. A series of comparative readings with a secondary standard extending over two days showed that the index error of the instrument was $-.014$ " and not $-.007$ " which was its amount when issued in January 1877 from Calcutta. The thermometers were all in good order. The anemograph was well exposed and in good working order.

OBSERVATORIES IN BERAR.—These are five in number, and are enumerated on page 30. One of them, Makhla, a 4th class observatory established and carried on by the Forest Department, sends its registers direct to the Imperial Office, and the remaining four are under the Sanitary Commissioner, but send in their registers to the Meteorological Reporter for Western India.

Akola was inspected by myself in February 1888. The shed was in excellent repair. The thermometers were in good order and very clean, and the anemometer well exposed and in good condition. The observer is very neat in all his arrangements and ranks amongst the best of our observers.

The remaining observatories were not inspected during the year. The office comparison of the observations taken at these stations during the year shewed that they were satisfactory, and probably accurate.

OBSERVATORIES IN CENTRAL INDIA AND RAJPUTANA.—These are the same as in previous years, and are enumerated on page 30. The Maharajah's observatory at Jey-pore, which is a first-class observatory, sends its registers to the Meteorological Reporter to the Government of the North-Western Provinces and Oudh. A brief description of the work done at that observatory, taken from Mr. Hill's report, is given on page 36. Of the remaining observatories, Nowgong, Sutna, Ajmere and Sambhar are under the Meteorological Reporter for the North-Western Provinces and Oudh, and Neemuch Indore, Mount Abu and Bickaneer under the Meteorological Reporter for Western India. Pachpadra sends its registers direct to the Imperial Office.

The observatory at Mount Abu was inspected by Mr. Chambers, Meteorological Reporter for Western India, in March 1887; Sutna by Mr. Hill, Meteorological Reporter to the Government of North-Western Provinces and Oudh, in August 1887, and Ajmere and Sambhar by myself in October 1887.

The Neemuch Observatory has been in a very unsatisfactory condition during the past year. The observer is ignorant and careless, and has made a very large number of mistakes in his observations during the year. As it is apparently hopeless to expect trustworthy observations from the present observer, it will probably be necessary shortly to remove the observatory, and place it on a different footing.

The Sutna Observatory was at the time of Mr. Hill's visit in a very efficient state.

The Ajmere Observatory has improved slightly during the past year, and was in very fair condition at the time of my visit. The instruments were clean and in good order. The observer appears to be attentive, but is by no means intelligent, and makes occasional stupid mistakes which render his work less trustworthy than it ought to be.

The observatories at Nowgong, Indore, Pachpadra and Bickaneer have not been inspected during the past year.

The barometric observations at Pachpadra during the past year, as stated in page 22, were utterly worthless. The Sambhar and Abu observations were on the whole satisfactory.

OBSERVATORIES IN BOMBAY.—These, excepting the Colaba Observatory, are all under the Meteorological Reporter for Western India and are enumerated on page 30.

The condition and working of these observatories during the past year is fully shown by the following extracts from the Administration Report of the Meteorological Reporter for Western India :—

"No new observatories have been established, but a new and complete set of instruments has been issued to the Zanzibar Observatory. Observations ceased to be recorded there in January 1885, in consequence of the death of Dr. Williams, the Agency Surgeon, but there is now a prospect of the work being resumed under Dr. Charlesworth, the newly appointed Agency Surgeon. Dr. Charlesworth had already recommenced the observations in December last, but they have since been interrupted by the sale of the building in which the meteorological instruments had been placed, and cannot be resumed until another suitable place has been found for them. No observations have been received during the past year from Mr. K. M. Joglekar, Head Master of the Sirdar's High School, Baroda, who, under the sanction of Government, was furnished with a complete set of instruments in 1883. * * *

"*Anemographs*—The large Beckley's anemograph at Deesa has been kept in continuous operation throughout the year, except on one day, when the observer forgot to lower the pencil on the paper. The similar instrument at Belgaum has produced continuous traces, except on three days, on one of which the clock stopped, and on two of which the trace was obliterated by excessive dampness of the atmosphere. The embossing anemometer at Poona has worked continuously except for a few hours on each of two days, when the instrument was being cleaned and re-adjusted. This instrument is now much worn and fails to record the wind arrows in a satisfactory manner. The similar instrument at Ratnagiri has failed to produce records on 17 days, on five of which the clock was out of order and on twelve of which the strip of paper on which the record is received was spoiled, chiefly by wet weather. * * *

"**OBSERVATIONS.**—The observations recorded throughout the year at Akola, Belgaum, Jacobabad, Buldana, Chikalda, Indore, Deesa, Bhuj, Mount Abu, Karachi, Sholapur, Ratnagiri, Malegaon, Karwar and Poona are, I believe, thoroughly trustworthy. At Neemuch the anemometer was out of action and under repair for about three months. No barometric observations were recorded at that station in September and October, because the instrument became deranged, and two others forwarded to supply its place were put out of order either during transit or after arrival at the station. At Amraoti the barometric observations were untrustworthy from about the 26th April to the 29th May, during which time the work had been entrusted to an incompetent man in the absence of the regular observer on leave. At Hyderabad the anemometer was out of order from the 11th July to the 23rd August, and most of the barometric observations during September had to be rejected as

untrustworthy owing to carelessness or neglect of the observer. At Calicut, also, the barometric readings from the 21st December to the 9th January were untrustworthy and were rejected owing to the same cause. In these cases the observers were punished for their neglect and they afterwards improved. At Surat, the barometric observations were unreliable during the greater part of January partly because the observer was absent on sick leave, and his substitute had no experience, and partly from a defect in a new instrument which misled the observer. * * *

"INSPECTION OF OBSERVATORIES.—During the year I have inspected the observatories at Sholapur, Poona, Surat, Mount Abu, Karachi, Hyderabad and Jacobabad. * * The observatories at Poona and Sholapur were in good order and the observers read the instruments accurately.

"SURAT.—The scale of barometer No. 22 was very dirty, and the glass cistern was very much obscured by oxidation of the mercury, but the zero point could still be seen, though not without difficulty. * * * On account of the obscurity of the glass cistern of barometer No. 22, another new instrument by Casella, on the Kew principle, No. 1373, had been supplied to the observatory, but I found this instrument reading about four-tenths of an inch too high, and was informed that the reading scarcely ever changed from 30·4". I consequently took off the outer brass tube, and then found a large bubble of air breaking the column of mercury in the contracted part of the tube which accounted for the high reading. * * After much shaking, the air was all expelled from the upper part of the tube above the air trap. * * * Afterwards it was fixed properly in position and compared with the standards. The results showed a fall of — '031" since the instrument was compared in Bombay before issue, most of which fall is probably due to some loss of mercury from the cistern. * * * The observer evidently does not take much interest in his work, for although he is a competent observer, and can take and record all the observations with great accuracy, everything had a dirty, neglected appearance, and I found numerous small defects.

"MOUNT ABU.—This observatory was inspected on the 1st February 1888. The erection of a new thermometer shed of the standard pattern had been completed only a few days before, and all the thermometers had been transferred to it. They were all in good order. * * After comparing the barometer with the standard instruments, I dismounted it, cleaned the cistern and filtered the mercury, after which it looked as good as new. The comparisons show that the index error had remained constant.

"KARACHI.—This observatory was inspected on the 15th March 1888. The barometer and all the thermometers were in very good order. So was the rain-gauge, except that the cylinder was stuck fast in the foot. * * * The observer was Minguel A. Fernandez. His readings of the instruments were taken very accurately, and his work was neatly and well done.

"HYDERABAD.—I inspected this observatory on the 18th March 1888. The old barometer, No. 32, was in good order, except that the scale was dirty. The glass cistern was however clean and the zero point was easily seen. * * The thermometers were in good order.

"JACOBABAD.—It was in much better order than the one at Hyderabad, the observer (Shaik Ali) being a much more competent and a more careful man. The barometer and thermometers were all in good order."

OBSERVATORIES IN MADRAS, MYSORE AND HYDERABAD.—Of the 21 observatories in these provinces enumerated in the list on page 30, all but five, *viz.*, the Madras Observatory and those of Gopalpur, Vizagapatam, Cocanada and Calicut, are under the control of Miss Pogson, Meteorological Reporter to the Government of Madras. Ten of these observatories have been inspected during the year, of which nine were visited by myself.

The following extracts from Miss Pogson's Administration Report give the more important facts respecting the condition of the observatories that were inspected during the year. :—

"BANGALORE.—Mr. Eliot inspected the observatory on the 18th of February 1888, in order to find out the cause of the anomalous readings of the barometer, and reported as follows:—

"The barometer is placed in a small room of the Bowring Hospital which has hitherto served as the office room of the observer. A long comparison was made by myself, and the instrument (a small one

with narrow tube and oxidized mercury) was condemned and replaced by No. 816 Casella. The observer read the instrument correctly. The thermometers were all in good order and fairly clean. The exposure of the anemometer and wind-vane was satisfactory. The anemometer was filthily dirty. I had to spend upwards of an hour cleaning it, and instructing the observer how to clean it. He was ordered to clean it thoroughly once every month for the next six months, and until the instrument is quite clean in every part. The observer can do his work well but is careless and apparently indolent.'

"BELLARY.—Inspected by Mr. Eliot who reported as follows:—'Observatory was formerly (up to 1886) near the town, in the compound of the old Municipal Hospital. The position was changed in that year to the compound of the new Civil Hospital, opened in 1886. It is in very open ground, behind a small hill of granite to the east of the Railway Station and Telegraph Office. The present position of this observatory is on the whole satisfactory. The barometer is a large Casella's Fortin instrument, No. 852. It is in good order, and the mercury surface in the cistern is quite clean. It was brought into use a year ago. The thermometers were in good order except the minimum, the column of which is very liable to break. The wind-vane and anemometer are on the roof of the hospital, and were in good order. Their exposure is very good.'

"COCHIN.—The old barometer was replaced by a new one, No. 1364 Casella, sent direct from Calcutta on the 26th of September 1887. Comparative observations were taken of the old and new instruments before the former was dismantled by the third assistant of the Madras office, who was sent to unpack and erect the new barometer.

"COIMBATORE.—This observatory was inspected by Mr. Eliot on the 22nd of February 1888, who reported as follows:—'Observatory is in the grounds of the Municipal Dispensary in the midst of the town in a not very satisfactory locality. The streets are broad, and fringed with many cocoanut and other palm trees. The immediate neighbourhood of the town is flat, but to the north and north-west rise the Neilgheries, and to the south the Anamalai Hills. The shed is in fairly good condition. The barometer is in good condition and the mercury surface fairly clean. A comparison showed that the index error is practically changed. The dry and wet minimum thermometers were both out of order. The columns were restored and instructions left as to future use of these two instruments. The wet minimum was thickly encrusted. The wind-vane and anemometer are exposed on the end poles supporting the shed, and the latter is approached by a ladder. The situation and exposure of the anemometer is not satisfactory.'

"CUDDAPAH.—This observatory was inspected by Mr. Eliot for the purpose of determining the cause of the anomalous barometer readings. He reports:—'The observatory is in the compound of the Municipal Dispensary. The ground in the neighbourhood is flat and devoted chiefly to rice cultivation by means of numerous tanks. About 5 miles to the east is the Palkonda range of mountains, running north and south, and rising about 1,000 feet above the plains. The dispensary is surrounded with trees, and the exposure of the observatory is hence not satisfactory. The barometer in previous use was a Kew principle No. 1277 by Casella. A series of readings were taken which showed that its error was not only very variable, but differed very considerably from those of previous determinations. The instrument was therefore condemned and replaced by Casella Fortin's No. 1362. Comparative readings were ordered to be taken for some time, in the hope that the law of error of the old instrument might be ascertained. The thermometers were all in good order. There was a very slight encrustation on the wet minimum. There is no anemometer or wind-vane. Arrangements were proposed by Mr. Blanford on his visit in 1886, but have not yet been carried out. The erection of the staging for the anemometer and wind-vane was delayed through want of funds to meet the expenditure.'

"KURNOOL.—This observatory was not inspected during the year, but the observations appear to have been carefully taken. The staging for the anemometer and wind-vane still awaits sanction and provision of funds for its erection.

"MADURA.—This observatory was inspected by Mr. Eliot to determine the cause of the anomalous barometric readings. He reported as follows:—'The shed was clean and in good order. The barometer, No. 1403, Adie, was placed in the operation room of the dispensary. The mercury surface in the cistern was much oxidized, and as I was hence unable to take satisfactory readings, I left the comparison to be made by the observer. The instrument should be replaced by a new one of standard type at the earliest opportunity. It was removed during my visit to another and more suit.

able room, but a cage is required to protect it.* All the thermometers were clean and in good order.'

"MANGALORE.—This observatory calls for no special remarks beyond a few words of praise for the creditable manner in which the work has been conducted by the Port Officer's clerk. The register was continuous, and the instruments appear to have been in perfect order throughout the year.

"MASULIPATAM.—There has been a decided improvement in the general working and condition of this observatory throughout the past year. As the thermometer shed was not sufficiently protected from cattle, a peon from the Madras office was sent with suitable fencing-posts and iron bars which were put up under his supervision. The observer's work has been satisfactory."

"MERCARA.—The one year's series of comparative observations at the old and new observatory sites was completed on the 31st of December 1887, and the work of observation at the Telegraph Office observatory was discontinued from that date. The records of the instruments at the Telegraph Office were used for the ordinary register and weather messages up to the 31st of May. From the 1st of June to the 31st of August the barometric readings at the Civil Dispensary of Fortins barometer, No. $\frac{57}{1878}$, Adie, and the thermometric readings of the Telegraph Office instrument were used, and from the 1st of September the readings of the same barometer and the records of the new thermometers supplied to the new Civil Dispensary observatory were used for the ordinary observations and weather telegrams. Barometer No. 954, Casella, on the Kew principle was finally removed from the Telegraph Office to a room in the Civil Dispensary on 1st of June. On the 6th of January I inspected both observatories and noted as follows:—Civil Dispensary observatory, Barometer No. 954, Casella, on the Kew principle was well placed, in a good light, clean and in perfect order. Barometer No. $\frac{57}{1878}$ suspended by its side had leaked so considerably that there was not sufficient mercury in the cistern to render it safe for travelling. A small quantity of mercury was put in, but it leaked again. The position of the new thermometer shed situated on a knoll, open all round, is a great improvement upon the site occupied by the old one in the Telegraph Office compound. The roof of the thermometer shed was rather thin, and there were no side screens to protect the instruments from the rising and setting sun and rain. The cage and thermometers were clean, well kept, and in good order. The anemometer and wind-vane had just been dismantled from their old positions. The former instrument was in a dirty state, dry and stiff for want of oil, the wheels worn, and in need of proper cleaning and oiling. It was taken to pieces, thoroughly cleaned and oiled, and set in good working order. The staging for the wind velocity and direction instruments consists of a few telegraph posts fastened together, with a ladder attached. The solar radiation thermometer and rain-gauge were exposed in a railed off enclosure of about seven feet square. The Telegraph Office thermometer shed was of the Calcutta pattern, but in a very dilapidated condition. The cage and thermometers were all clean and in order. The observer at the Civil Dispensary is the civil surgeon's clerk. He read the instruments correctly, and seemed interested in his work. The observations have been carefully made, and the general condition of the observatory was satisfactory.

"NEGAPATAM.—This observatory was inspected by Mr. Eliot on the 24th of February 1888. The following is his report:—'The observatory is unchanged in position and condition of exposure since my last visit. The shed was clean and in good condition. The barometer and thermometers were all clean and in a satisfactory state. The wind-vane and anemometer were clean, and in good order.'

"RAJAHMUNDY.—This observatory was not inspected during the year, but judging from the returns, the observations appear to have been carefully taken.

"SALEM.—This observatory was inspected by Mr. Eliot. The following is his report on the condition of the station:—'The observatory is about four miles from the Railway station, and in the compound of the Collector's office quite close to the dak bungalow. The situation is open, and exposure satisfactory. To the north and north-west are the Shevaroy Hills, and to the south a high nameless range. The barometer has been in use since 1880. A series of comparative observations was taken of the observatory barometer with a secondary standard which showed that the index error was unchanged, and that the instrument was a very satisfactory one. The observer is apparently careful and accurate in his work.'

* A new barometer and cage have since been supplied.—J. E.

"SECUNDERABAD.—Inspected by Mr. Eliot who reported as follows :—'Shed is in good condition and clean. Barometer is a very small and poor instrument by Negretti and Zambra. It has been in use nearly six years. The mercury surface is fairly clean. The barometer is suspended in a capital position, with very good light, in a small room of the hospital. The observer read it correctly and quickly. The thermometers were all in good order. The wind-vane and anemometer were clean and working satisfactorily.'

"TRICHINOPOLY.—This observatory was inspected by Mr. Eliot, chiefly to arrange for the completion of second class observations next year. His report is as follows :—

'The observatory was removed from its previous position in the compound of the European Hospital near the Railway station in 1885 to a piece of ground between the Superintendent and District Engineer's offices, and quite close to the public gardens. The position is fairly open, but as usual in Indian towns, there are many trees near the shed which to some extent affect the observations. The mercury surface of the barometer was much oxidized and dirty, and hence it was not possible to make a comparison except through the observer. A new and better instrument is desirable.* The thermometers were all clean and in capital condition. The wind-vane and anemometer are erected on a high wooden staging, well above adjacent trees and buildings and are in very good order.

"WELLINGTON.—This observatory was not inspected during the year, but the work has been quite satisfactory. The barometer was removed from its former objectionable position in a little room, to a more open and suitable one on the same ground level after the 10 P.M. observations on the 15th of April."

OBSERVATORIES IN BURMA.—There are in all eleven observatories in Burma, of which Akyab is under the administration of the Meteorological Reporter to the Government of Bengal, and Diamond Island, Mandalay, Bhamo and Kindat under the Central Office. The remainder are under the Sanitary Commissioner for Burma, but send their registers to the Imperial Office. Rangoon, Toungoo, Thayetmyo, Bassein and Moulmein were inspected by the Sanitary Commissioner and found to be generally in good working order. The Rangoon Observatory continued to work very unsatisfactorily during the early part of the year, and the observations showed such large and numerous discrepancies as to indicate great carelessness on the part of the observer. It was hence decided to reduce it to a third class observatory, and to place it under different conditions. I visited Rangoon in December, and with the ready assistance of Mr. Gilbert, Rector of the Rangoon College, was enabled to place it on a satisfactory footing. Dr. Romanis, Science Professor, kindly undertook to act as Superintendent, and one of the masters of the Rangoon College was selected as observer. The observations have been, since the change, very satisfactory.

I also inspected Mergui, Thayetmyo and Toungoo. The observatory at Mergui was in very good order and the observer efficient. The index error of the barometer was found to be practically unaltered. That at Toungoo was in a satisfactory condition, and the instruments, with the exception of the wet bulb, clean and in good order. A careful comparison of the barometer with a secondary standard (by means of 10 readings taken in two days) showed that the index error has altered considerably since its issue from Calcutta in April 1882. The observatory at Thayetmyo was in fair condition. The observer was absent on leave and his substitute was neither accurate nor careful in his work. Two of the thermometers, the dry minimum and grass radiation thermometers, were not in good order, as portions of the column were detached. The barometer was in good order, and its index error relative to the Calcutta standard found to be practically unchanged. Moul-

* [This has since been sent.—J. E.]

mein was inspected by the head clerk of the Bengal Office in March 1888. The barometer was out of order as some air had found its way into the vacuum. Another instrument was shortly afterwards supplied. The wind-vane had not been oiled since its erection, and failed to move except under violent winds. The other instruments were in fair order. The barometric and wind observations at this station hence have been erroneous for some time. The observer's attention was called to the discrepancies in the observations for some months prior to the inspection, but he was unable to give any explanation. He was, it may be added, the recipient of a special allowance.

OBSERVATORIES AT THE BAY ISLANDS.—The three observatories in the Bay Islands, enumerated in page 30, require inspection, but I was unable to arrange for it during the cold weather. No special report has been received on their working and condition. The observations taken at Nancowry, that were submitted to the office during the year, contained many discrepancies such as can only be explained by inaccurate readings of the instruments or careless preparation of the returns. The returns from Port Blair also contained occasional readings which it was difficult to reconcile with the coast observations. A satisfactory explanation of these doubtful readings has not yet been received. This is much to be regretted, as the observations at these two island stations are of very considerable importance at present, and will become of very great value in connection with the storm signal service, should they ever become connected telegraphically with India.

EXTRA INDIAN OBSERVATORIES.—There are now seven of these, one having been lately established at Baghdad in Turkish Arabia. With the exception of Amini Divi, which is controlled by the Meteorological Reporter to the Government of Madras, the others send their registers direct to the Imperial Office. Aden has improved very greatly, and the observations have been sent in throughout the year with due regularity. The Leh Observatory, under the superintendence of the Revd. F. A. Redslob of the Moravian Mission, has sent in valuable and reliable observations during the past year.

The observatories at Bushire and Katmandu have worked fairly well.

The observatory at Quetta has continued to send in accurate observations.

The Amini Divi observatory has submitted a satisfactory and fairly trustworthy set of observations for the past year, and is now a useful and valuable station. Miss Pogson reports on that observatory as follows:—

“**AMINI DIVI (LACCADIVES).**—The hospital assistant in charge of this observatory left the island to obtain provisions, and on attempting to return, his boat was driven ashore at Cochin, and as all communication between the island was cut off, he had to remain there until it was restored some months later. During his absence, however, the work appears to have been carried on satisfactorily by the hospital compounder who had been instructed to read the instruments by Mr. D'Cruze. On reaching the island, the permanent observer reported that all the instruments were in perfect order, with the exception of the surface of the mercury in the cistern of the barometer which had become oxidized.”

INSTRUMENTS.

In Appendix A is given a return of the instruments in store at the beginning and end of the year, and of those received and issued by the India Meteorological Office during the year, and includes the stock, receipts and issues of the Alipore Observatory.

METEOROLOGICAL OFFICERS AND OFFICE WORK.

The general administration of the Meteorological Observatories and Offices in the different Provinces, with the local exceptions noticed in the foregoing sections, has been in the hands of the following officers during the year :—

Names.	Office.	Province.
H. F. Blanford, Esq., F.R.S.	Meteorological Reporter to the Government of India.	Central Office.
J. Eliot, M.A., F.R. Met. S. (Offg.)		
W. L. Dallas, Esq. . . .		
Babu Hem Raj	Assistant Meteorological Reporter to the Government of India.	Central Office.
	On probation as Personal Assistant to the Meteorological Reporter to the Government of India.	
J. Eliot, M.A. . . .	Meteorological Reporter to the Government of Bengal.	Bengal and Assam.
A. Pedler, Esq. F.C.S. (Offg.)		
S. A. Hill, Esq., B.Sc. . . .	Meteorological Reporter to the Government of North-Western Provinces and Oudh.	North-Western Provinces, Oudh, Rajputana and Central India (part).
W. L. Dallas, Esq. . . .	Meteorological Reporter to the Government of Punjab.	Punjab.
F. Chambers, Esq. . . .	Meteorological Reporter for Western India	Bombay, Berar, Rajputana and Central India (part).
Miss Isis Pogson, F.R. Met. S.	Meteorological Reporter to the Government of Madras.	Madras, Mysore, Coorg, and Hyderabad.
Dr. J. H. Loch	Sanitary Commissioner, Central Provinces	Central Provinces.
Dr. C. Little	Sanitary Commissioner, Berar	Berar.
Dr. D. Sinclair	Do. do. Burma	Burma.
Surgeon-Major A. E. Dalgairns.	Senior Medical Officers, Bay Settlements	Andamans and Nicobars.
Surgeon-Major G. P. Mackenzie (Offg.)		

Mr. Blanford went on furlough on the 1st of May, and I acted for him during the remainder of the year.

Mr. A. Pedler officiated as Meteorological Reporter to the Government of Bengal during the same period.

Babu Hem Raj was selected by Mr. Blanford as successor to Lalla Ruchi Ram Sahni, but he was at first appointed temporarily and on probation, and his permanent retention was made contingent on his passing a departmental examination, the subjects of which were fixed by Mr. Blanford.

The following table shows the number of stations, the registers of which were sent to each of the Reporters respectively, for reduction and verification during the year under report :—

PROVINCE.	METEOROLOGICAL REPORTERS.						TOTAL.
	India.	Bengal.	North-Western Provinces and Oudh.	Punjab.	Western India.	Madras.	
Bengal and Assam	4	20	...	...	...	...	24
North-Western Provinces and Oudh .	1	...	14	...	...	...	15
Punjab	2	...	...	11	...	...	13
Rajputana and Central India . . .	1	...	4	...	4	...	9
Central Provinces	11	...	...	...	...	...	11
Berar	1	...	...	...	4	...	5
Bombay . . . . .	...	...	...	...	13	...	13
Madras, Mysore and Coorg . . .	1	2	...	...	1	16	20
Burma	10	1	...	...	...	...	11
Bay Islands	3	...	...	...	...	...	3
Extra Indian	6	...	...	...	...	1	7
	40	23	18	11	22	17	131

The list does not include the registers of the 28 provincial observatories in Bengal which are prepared and utilized in the Bengal Meteorological Office, nor those of the Colaba, Madras and Jeypore Observatories, which are furnished to the Meteorological Office with all the necessary reductions.

In Bengal, the North-Western Provinces and Madras, the Reporters collect the rainfall registers of the district and sub-divisional stations of their respective provinces. The Bengal Reporter publishes weekly and monthly rainfall returns of the Province, the North-Western Provinces weekly returns, and the Madras Reporter monthly returns in the respective provincial gazettes.

The number of rainfall stations sending returns to each of the above officers is as follow :—

	Stations.
Bengal	250
North-Western Provinces and Oudh	275
Madras	315

Mr. Hill makes the following remarks on rainfall registration in the North-Western Provinces during the past year 1887-88 :—

“The registration of rainfall in the North-Western Provinces and Oudh was continued on the same lines as in the previous year. Including the records of all the Revenue stations and the Meteorological observatories, as well as voluntary observations by Mr. G. J. Bellairs, of the Chowkuri Tea Plantation in Kumaun, observations at the Pilgrim Hospitals in Garhwal, and a selection from those made at canal stations, regular registers of rainfall at 275 stations in the province are maintained. At the majority of the stations the old float gauge is still used, but gauges of this kind are gradually

being replaced by Symons' five-inch gauge with measure glass. In addition to the stations mentioned in last year's report, the following have been supplied during the year with the new gauges :—

Muhammadabad in Farukhabad district.
Fatehpur Sikri in Agra district.
Deoriain Gorakhpur district.

Champawat in Kumaun district.
Pithoragarh in Kumaun district.
Nanpara in Bahraich district.

Kaisarganj in Bahraich district.

Altogether, including the observatories, there are now about 100 stations with the improved gauges. It seems hopeless, however, for the present, to look for much improvement in the character of the returns, even where good gauges are used. Those revenue stations where a check is afforded by the presence of a meteorological observatory show only a little more favourably than they did last year, as may be seen from the following table :—

STATION.	TOTAL RAINFALL OF 1887.		NUMBER OF DAYS ON WHICH RAIN WAS MEASURED.	
	Observatory.	Táhsil.	Observatory.	Táhsil.
	Inches.	Inches.		
Dehra	83'07	79'44	96	79
Roorkee	46'74	42'00	71	32
Meerut	27'24	27'52	51	46
Bareilly	41'70	36'70	62	46
Agra	43'04	39'88	54	45
Allahabad	36'98	40'56	78	49
Benares	33'56	37'12	72	50
Gorakhpur	38'36	41'40	65	53
Gházípur	36'13	33'33	67	53
Jhánsi	52'55	51'29	72	48
Pithoragarh	48'68	41'80	123	87
Ránikhet	40'63	40'16*	101	79*
Lucknow	35'24	34'50	67	55

* At the treasury.

"The excess of the total rainfall at the observatories was by no means so general as in 1886; but at every observatory numerous slight, though measurable, falls of rain were noted which were neglected at the neighbouring tahsil, and the Roorkee tahsil, which is probably not the worst in the Province, had again the distinction of noting less than half the total number of rainy days."

The Reporters for Bengal and Western India administer a system of storm warnings for the protection of the local ports. The changes and extensions that have been either introduced or sanctioned during the past year are described fully in pages 10 to 17.

The meteorological observations copied from the log-books of ships entering the port of Calcutta which continue to be received, are tabulated in the Central Office, Calcutta.

Mr. Dallas has assisted me during the year in preparing the daily weather report and chart, and also discharged the duties of the Meteorological Reporter for the Punjab. He finished during the year the reduction and preparation for publication of the marine observations relating to the Arabian Sea, received in 1877 and 1880 from the London Meteorological Office, and a volume containing charts, barometric, wind and current data of the Arabian Sea, with a descriptive text, was printed and issued during the year.

OFFICE ESTABLISHMENTS.—The following is a return of the number of ministerial officers and menial servants in the offices of the several Meteorological Reporters :—

	INDIA.		Bengal.	North-West- ern Prov- inces.	Punjab.	Western India.	Madras.	TOTAL.
	Calcutta.	Simla.						
Head Clerks . . .	1	...	1	1	1	1	1	6
Computers . . .	3	...	...	...	...	...	...	3
Clerks and copyists . .	5	...	2	1	3	...	4	15
Tabulators . . .	14*	6	10	4	...	8	...	42
Draughtsmen . . .	2†	1	1	...	...	...	...	4
Artisans . . .	...	...	3	...	...	...	...	3
Peons and menials . .	7	5	5	2	2	2	2	25

* Besides these, there were four temporary clerks during the first two months for reducing the London Meteorological Office marine logs.

† Besides these, there was one temporary draughtsman for drawing up the marine charts.

Babu Fanindra Mohun Basu has continued in charge of the Central Office in Calcutta, and maintained it in a high state of efficiency during the past year.

The Local Reporters state that their respective offices have worked satisfactorily.

WEATHER BULLETINS AND STORM-SIGNAL SERVICE.—Since the 8th April 1885, the daily weather reports issued under the authority of the Department of Revenue and Agriculture have been drawn up at Simla, a permanent establishment being retained there for the purpose. The changes made in the form of the report during the previous year have been described in pages 9 and 10, and it is unnecessary to repeat them. The substance of the verbal summary, which accompanies each issue, is telegraphed to all the Provincial Governments, and copies are furnished to the daily newspapers at Calcutta, Allahabad and Bombay.

An average of two hundred and ninety-five copies of the daily report were printed daily at the commencement of the year, and two hundred and fifty-nine at the end of the year. The reduction in the number published was effected by discontinuing them to the great majority of the district officers in Bengal, who receive the provincial report and therefore do not require the India daily report. It was issued daily to a large number of Government officers and to a few European Meteorological Societies and distinguished meteorologists, with the approval and sanction of the Government of India.

As a part of the work connected with the daily reports, notice is sent by urgent telegram to the Meteorological Office, Bombay, of the progress of any storms that advance from the Bay of Bengal towards the Western Presidency. Notice is also sent by urgent telegram to the Civil and Political Officers of Khandesh and Guzerat of the appearance of storms likely to produce floods in the Tapti and Nerbudda. Arrangements are also in force for telegraphing direct to the same officers from certain observatories, *viz.*, Jubbulpore, Hoshungabad and Khandwa (in the upper drainage basins of these rivers), the occurrence of heavy rain, in order to give them due warning of probable floods.

The Bay of Bengal reports of the storm-signal service were published every day without any break during the year by the Bengal Meteorological Office. The Lithographic

Branch of the Survey Department supplied the printed skeleton maps as in previous years. Four stations on the Burma coast, *viz.*, Rangoon, Moulmein, Bassein and Tavoy, have been added to the reporting stations. Pooree has also been recently included, and three more stations on the Madras coast are shortly to be added, when the report will become very fairly complete. The total number of stations in connection with the Bengal storm-signal service that report the observations daily by means of telegrams is now 25, and with the addition of Bimlipatam, Nellore and Cuddalore on the Madras coast it will shortly be 28 in all. The daily weather report observations were in 1887-88 and in previous years taken at 10 A.M., but, as stated previously, the hour of observation has been changed experimentally to 8 A.M. from 1st April 1888. The telegrams were received very regularly from almost all the stations. This report was supplied during the year to 33 Government officers and 22 subscribers paying at the rate of ₹2 a month. The receipts from the subscribers during the year have covered the cost of lithographing the reports in the Bengal office and distributing them. There was a balance of ₹115-10-6 at the end of 1887-88.

During the year the Bengal provincial daily weather reports were published during the period 30th April to 7th November. Forty-one stations sent in daily observations by means of telegrams against 38 of the preceding year. This increase is due to the addition of the stations of Sibsagar, Dhubri and Silchar to the list.

The Bay of Bengal was singularly free from large cyclonic storms during the year, more especially in the months of October, November and December. The following extract from Mr. Pedler's report describes the storm-warning work done by the Bengal Reporter during the year:—

“STORM SIGNALS.—During the year the procedure with reference to hoisting storm signals in Bengal was revised under Government of Bengal Notification, dated 4th August 1887, published in the *Calcutta Gazette* of the 10th August 1887. Under this notification the Bengal Meteorological Reporter is now charged with the duty of actually ordering the hoisting of all the storm signals, not only at Calcutta and the approaches to it, but also at Chittagong and the various Orissa ports, and without orders from the Bengal Reporter no signal at these ports can be hoisted.

“By the same notification also, a slight alteration was made in the meaning of one of the storm signals, which had been for some years in use in the river approaches to Calcutta. By this notification there is now one signal which can be hoisted when the indications which are given of the formation and line of advance of a storm are not well defined. This signal is called a bad weather preparatory signal, and it merely means that a cyclonic storm of undetermined intensity and magnitude has formed in the Bay of Bengal, which is too far off to enable its line of advance to be ascertained with certainty. This will probably be a very useful addition to the Code of Signals.

“A further and more important change which was also made in this notification was to extend the use of the full code of storm signals, which had hitherto only been employed in the river approaches, to the port of Calcutta as well. Hitherto information as to the nature and size of storms in the Bay has in some cases only been able to be conveyed to ships while they were actually passing down the river, or, in other words, while actually proceeding towards the danger. By the change which has now been brought about after sundry efforts of the Meteorological Department, full information will be able to be communicated to ships of storms in the Bay before they leave the port, and their safe anchorage.

“HOISTING OF STORM SIGNALS.—During the year it was only necessary to hoist the storm signals in the river Hooghly on two occasions, *viz.*, first during the Balasore cyclone of May 20th to 26th, 1887, when the signals were ordered to be hoisted at the signal stations of Diamond Harbour, Mud Point and Saugor Island from 8 o'clock on the morning of the 25th May to 7 A.M. of the 27th May, and the second time during the storm in June from 1 P.M. of 12th to 1-25 P.M. of the 14th.

“BALASORE CYCLONE, MAY 20TH TO 28TH, 1887.—The formation of the Balasore cyclone on the 20th May was notified in the Bay of Bengal Daily Weather Report, and its development and advance

towards the land were dealt with in the succeeding days' reports until it reached the Balasore coast on the morning of May 26th. During the formation and advance of the storm towards the land, warnings of its existence and line of march were issued widely to the ports round the Bay of Bengal, and to the various officers appointed to receive such warnings. Full and detailed reports of the action taken by this office during this storm have already been submitted during the year, and it is therefore not necessary to repeat them here. A full and detailed description of the Balasore storm has been published by Mr. Eliot, as Part I of the Cyclone Memoirs.

"CYCLONIC STORM OF JUNE 10TH TO 14TH, 1887.—The second cyclonic storm, which was also of very considerable intensity at sea, formed in the northern half of the Bay from the 8th to the 10th of June. It gradually increased in intensity and slowly travelled in a westerly direction, crossing the coast about midway between Gopalpur and Vizagapatam on the 13th. The lowest pressure recorded was 29.3 inches at Gopalpur on the night of the 13th. Reports from ships involved in the storm shewed that very strong winds with a high sea and very bad weather, accompanied the storm in the Bay.

"A considerable number of smaller and more feeble barometric depressions occurred during the prevalence of the south-west monsoon over the Bay. These are detailed in the monthly summaries issued from this office. The principal smaller storms in 1887 were—

"STORM OF JUNE 19TH TO 22ND.—It formed as a shallow depression to the south-east of Saugor Island on the 19th, giving general heavy rainfall to South-West Bengal and Orissa. It passed inland in a north-westerly direction, and on the 20th the centre was between Burdwan, Bankoora and Raneegunge, where the cyclonic circulation of winds was most distinct, and on the 21st it had reached South Behar. This storm gave very heavy rainfall in its advance.

"In July there were 4 feeble storms—

The 1st from July 2nd to 8th;

The 2nd from July 9th to 13th;

The 3rd from July 11th to 17th;

And the 4th from July 19th to 28th.

These four depressions all affected the central, western and south-western districts of Bengal only, and by the rainfall they brought up, they caused the rainfall in July of these districts to be heavier than it otherwise would have been, and thus many parts of these districts received falls in excess of the normal, while considerable tracts of the north and east of the Province received very deficient rainfall. The first three storms were of little importance. The fourth small storm however was rather a noticeable one. It formed to the east or south-east of False Point on the 19th, and it remained almost stationary, moving only slightly from day to day in the north-west angle of the Bay until the 24th. On the morning of the 25th it had moved slowly inland, and then travelled through the south of Chutia Nagpur to Jubbulpore and Sutna, where it disappeared.

"In August two depressions were formed. The first existed from the 14th to 20th August 1887. It was a remarkably persistent storm, though the barometric depression at its centre was feeble. It was formed in the centre of the Bay, and crossed the South Orissa coast a little to the south of Gopalpur on the 19th, and drifted into the Central Provinces. The sea was rough, and weather squally in the Bay during this storm.

"The second small storm was formed in South-East Bengal on the 26th and 27th, and moved in a westerly direction through South-West Bengal to Chutia Nagpur, where it dispersed.

"In September there were three small storms.

"The first depression lasted from September 9th to 12th, and crossed the coast between Saugor Island and False Point.

"The second existed was a very brief storm, and lasted from the morning of the 15th to the evening of the 16th. It crossed the coast near Balasore.

"The third storm lasted from the 22nd to the 26th. It was formed close to the Sunderbuns to the south or south-west of Burrisal, and gave for a day or two very heavy weather at the head of the Bay. It afterwards advanced inland in a northerly or north-north-easterly direction, and broke up finally in North Bengal on the 26th.

"In October there were two cyclonic storms formed in the Bay.

"The first lasted from October 8th to 11th. It formed to the west of the centre of the Bay, and crossed the coast of Madras between that station and Masulipatam, and afterwards almost crossed

the Peninsula moving in a north-westerly direction. It was not a violent storm, but it gave a gale of wind at Madras, and as far north as Cocanada and Vizagapatam, and also heavy rain along the coast. This storm was however, exceptionally important to Bengal, for at the period when the storm was formed, the monsoon rainfall had practically ceased in the province, and some parts of the country had received such deficient falls that the crops were withering up. The effect of the storm in the Bay was to cause a late advance of humid winds up the Bay, and a wave of rainfall passed over the province lasting from about the 10th to the 15th, and though the rainfall was not very heavy, it did an immense amount of good.

"The second storm existed from October 27th to 31st. It began to be formed in the south-east of the Bay with squally weather and strong winds on the 27th. It drifted in a westerly direction, and was opposite the coast between Madras and Negapatam on the 29th. On the 30th it was opposite Madras, and on the 31st to the north-east of that station, and as it approached the land it filled up, causing general disturbance over the Bay which lasted till early in November.

"Another small barometric depression was formed in the centre and south of the Bay in the middle of November, and drifted to the Madras coast on the 18th. From this date no further storms were formed in the Bay till the end of the year. The retreat of the south-west monsoon down the Bay in 1887 was therefore unusually quiet, though the commencement of the monsoon had been marked by one of the fiercest storms on record, *viz.*, the Balasore cyclone of May."

Mr. Chambers describes his storm-signal work during the year as follows:—

"*Storm-Warning Service.*—This service has been carried on as in previous years. Daily telegrams are received from nine stations on the West Coast of India, and from three on the Coromandel Coast.

"The following table shows the dates on which warnings were issued, and the nature of the warnings:—

Names of Ports.	Dates on which telegraphic orders to hoist the storm signals were issued.	Dates on which cautionary telegrams were issued.
Karachi . . . . .	. . . . .	9th June, 15th July, 16th July, 18th July and 4th January.
Bhavnagar	15th July	9th June and 4th January.
Daman	15th July and 4th January	9th June.
Bombay	4th January	15th July.
Alibag	4th January	8th June, 9th and 10th October.
Ratnagiri	11th October and 4th January	8th June, 9th and 10th October.
Vingorla	11th October	8th June, 9th and 10th October.
Goa	11th October	8th June, 9th and 10th October.
Mormagao . . . . .	. . . . .	9th, 10th and 12th October.
Karwar	11th October	8th June, 9th and 10th October.
Kumta	11th October	8th June, 9th and 10th October.

"On the 5th of June the regular Daily Telegraphic Weather Reports gave some indications of the formation of a slight barometric depression off the coast of the Konkan. Special reports were called for from inland stations, and on the arrival of these reports on the 6th, it was found that on that day the depression had deepened somewhat and moved northwards. The gradients were, however, nowhere steep, and the winds were nowhere strong, and therefore no storm warnings were issued. On the 7th the depression was still deeper and the winds had now become decidedly cyclonic, but as they were not strong, no warnings were issued. On the 8th the depression at land stations was about the same as on the previous day, but the winds had strengthened considerably, and cautionary telegrams announcing the existence of the disturbance were sent to all the coast ports between Bombay and Kumta. On the 9th the barometer rose everywhere, the winds became weaker, and the depression moved northwards. Cautionary telegrams were then sent to Karachi, Daman and Bhavnagar. On the 10th a further rise of pressure took place, but the wind continued to blow

strongly at Bombay. On the 11th the disturbance had disappeared. Subsequent investigation has shown that this disturbance was caused by the formation off the coast of Bombay of a severe cyclone which moved westward, and in which both the outgoing and incoming English mail steamers as well as many other vessels were involved. There is little doubt that one large vessel, the *Lamport*, foundered in this cyclone, and many others were much damaged.

"About noon on the 15th July, a telegram was received from Simla announcing the existence on the 14th of a slight barometric depression near Raipur, moving westward. Telegrams from the northern inland stations were at once called for, and at 8-15 P.M., the following telegram was sent to the Port Officers of Karachi and Bombay:—'There is a cyclonic depression of the barometer at Indore. It is moving in a west-north-west direction. It will probably cause rough weather in Guzerat.' The same telegram was sent to Bhavnagar and Daman, with orders to hoist the storm signals. At 8-25 P.M., the following telegram was sent to the Collectors of Surat, Broach and Ahmedabad, and to the Agent of the Bombay, Baroda and Central India Railway:—'A cyclone is passing in a west-north-west direction across the Narbada Valley into Guzerat. It may cause floods in one or more of the Guzerat rivers.' On the 16th the centre of the depression was near Bhuj, and had partly filled up. On the 17th it had passed out of the field of observation to the westward to Karachi.

"On the 9th October the regular daily telegrams shewed that a small cyclone had crossed the Coromandel Coast near Madras. Special telegraphic reports were immediately called for from inland stations in the Peninsula, and at 9-30 P.M. its character had been sufficiently well determined to make it possible to issue the following cautionary telegram to all the ports between Bombay and Kumta:—'A small cyclone crossed the Coromandel Coast near Madras this morning, moving west-north-westward.' On the 10th the centre of the depression had moved to near Dharwar, and the Port Officers were informed of the fact. On the 11th the centre was between Belgaum and Goa, and the depression had deepened somewhat. Orders were then issued to hoist the storm signals at all the ports from Ratnagiri to Kumta. On the 12th the depression extended northward along the Ghâts, and on the 13th it had partially filled up and passed inland in a north-easterly direction between Poona and Sholapur.

"On the 3rd January 1888 the regular daily telegrams indicated the existence of a very slight depression on the Bombay Coast, the centre of which was probably between Karwar and Goa, and a note to that effect was made in the daily report to the Port Officer, Bombay. On the 4th, before the arrival of the telegraphic reports, a moderate gale sprang up at Bombay from north-east. As soon as the telegram from Ratnagiri arrived, the gale was seen to be of cyclonic character, and shortly before noon the following telegram was sent to the Port Officers at Bombay, Alibag and Ratnagiri:—'Centre of small cyclone now off coast between Ratnagiri and Bombay. Hoist storm signal.' A few minutes later a similar telegram was sent to Daman, and cautionary telegrams were issued to Bhavnagar and Karachi. This small cyclone appears to have passed inland in a north-easterly direction after crossing the coast between Bombay and Surat. It caused excessive and very unusual rain in the basin of the Tapti, and rapidly broke up. On this occasion the storm signals were hoisted too late to be of much use, although they were hoisted as soon as the disturbance was known to be of a cyclonic character, and without waiting for any information from the inland stations. Indeed, before any special information could be obtained from inland stations, the storm had disappeared."

WEEKLY, MONTHLY AND SEMI-ANNUAL REPORTS.—A descriptive summary of the weather was prepared monthly during the year and published in the *Gazette of India*. A report on the winter and spring snowfall was also drawn up in June, and a forecast of the character of the rains was attempted, which has been noticed in Part I of this report. Weekly meteorological reports have also been published throughout the year in the *Gazette of India*, giving a short *resumé* of the weather of the week, drawn up partly from the daily reports for the period, and partly from additional rainfall information obtained by telegram from a large number of stations.

Charts of the rainfall for the three seasons into which the year has been divided for this purpose (*viz.*, the cold season, the hot season and the rains) have been prepared for

1887 from the rainfall registers received by post, and several copies furnished to Government, but these are not published. A general chart and tabular return of the rainfall of the year 1887 was also prepared for the Secretary of State.

In Bengal, weekly and monthly meteorological and rainfall reports for the province are published in the *Calcutta Gazette*, and sets of three rainfall charts, showing the actual distribution of the rainfall and its variation from the average, *first*, in absolute measurement, and *second* as a percentage of the normal average, are prepared monthly for the Government of Bengal. A general summary of the weather of the south-west monsoon and the distribution of the accompanying rainfall in Bengal was also drawn up for the Local Government.

In the North-Western Provinces and Bombay, monthly abstracts of the registers of the several observatories, and, in the former, weekly rainfall reports, are published in the local *Gazettes*; and in the Punjab, since the beginning of 1886, a descriptive summary of the weather of the province, together with a chart showing the distribution of the rainfall of the month, and the mean winds and pressure at the twelve observing stations in the Punjab, has been prepared monthly for Government and published in like manner.

ANNUAL REPORT.—The report on the meteorology of the year 1886 was complete and in the printer's hands in August 1887, and the printed report submitted to Government on the 31st January 1888.

The report gives tables of temperature for 137 stations, and rainfall returns for 500 stations, being an increase of four in each case on the numbers respectively given in the report for 1886. The returns of the other meteorological elements are nearly as numerous as those of temperature. The elements tabulated in the Appendix are given in the following table. For comparison, the corresponding numbers for the four previous years are given:—

	NUMBER OF STATIONS.				
	1882.	1883.	1884.	1885.	1886.
Equilibrium temperatures of solar radiation	112	111	113	104	109
Duration of bright sunshine . . . . .	...	2	3	4	6
Temperatures of nocturnal radiation	104	107	106	108	108
Temperatures of the ground	4	4	4	5	5
Mean and extreme air temperatures	130	134	138	133	137
Sea-level equivalents of mean temperatures	108	111	112	111	113
Means and extremes of atmospheric pressure	124	125	127	128	132
Sea-level equivalents of mean atmospheric pressure	108	109	110	110	111
Direction and movement of winds	125	127	128	128	132
Temperature of evaporation	120	124	128	131	127
Tension of atmospheric vapour	127	130	135	130	134
Mean relative humidity	127	130	135	130	134
Mean proportion of clouded sky	124	127	130	131	135
Inches of rainfall in each month	457	462	478	486	500
Number of days on which rainfall was measured	457	462	474	482	500

The descriptive letter-press discusses the chief characteristics of the meteorology of the year. It includes tables of the average values of all the more important meteorological elements for all stations that have furnished returns for three years and upwards, and the report is illustrated with five plates, *viz.*, a chart showing the position of all observatories and rain-gauge stations, three in coloured lithography representing the mean distribution of temperature, pressure and winds in each month of the year, and one showing the tracks of the storms which originated in the Bay of Bengal during the year.

The original observations of seven observatories, *viz.*, Calcutta, Lucknow, Allahabad, Lahore, Nagpur, Bombay and Madras, were issued as a distinct publication in monthly parts. Those forming the volume for 1887 were completed in April 1888.

The Reporters for Bengal, the North-Western Provinces, the Punjab and Western India each prepared and submitted to the local Governments summaries of the weather features of the year in their respective provinces.

Appendix B gives a list of the Government Officials, Libraries, Observatories, Societies, &c., to which the publications of the office are presented, including those which send their own publications in exchange.

LIBRARY.

The additions to the library during the past year are enumerated in Appendix C. The library remains, as last year, in ten double book-cases in a large room on the ground floor of the office building. It is in good order, but it has not been practicable to undertake its re-arrangement, no officer having been available for the purpose.

JOHN ELIOT,

Offg. Meteorological Reporter to the Government of India.

CALCUTTA:

The 17th July 1888.

APPENDIX A.

Return of the Stock, Receipt and Issue of Instruments for the year 1887-88.

Instruments.	In store on 1st April 1887.	Received, 1887-88.	Issued, 1887-88.	In store on 31st March 1888.
Barometer Observatory, Fortin's principle	12	16	19	9
Do. do. Kew do.	8	9	9	8
Do. Mountain, portable Tripod (Adie)	14	4	5	13
Do. Marine, Kew principle	20	5	5	20
Do. Newman's large standard	1	...	1	...
Do. Negretti and Zambra (various)	8	1	2	7
Do. Aneroids	16	2	3	15
Hick's Barograph	1	...	...	1
Thermometers, standard with attached scales,	11	18	1	28
Do. do. without attached scales . . . . .	...	6	...	6
Do. for Hygrometers (Kew pattern)	65	45	33	77
Do. Maximum for shade	47	38	11	74
Do. Solar in vacuo (self-registering)	17	28	7	38
Do. do. do. (non-self-registering)	26	1	1	26
Do. do. not in vacuo	2	...	...	2
Do. Minimum for shade	27	41	25	43
Do. do. for radiation	32	13	23	22
Sling thermometers	14	1	2	13
Chemical thermometers	6	1	...	7
Six's thermometers	7	...	...	7
Traveller's maximum and minimum thermometers, in pairs	6	...	1	5
Frankland's sun thermometers	3	...	...	3
Boiling point thermometers	7	...	...	7
Thermograph with Negretti and Zambra's sets of recording thermometer	1	...	...	1
Ponillet's Pyrheliometer	1	...	...	1
Stewart's Actinometers (thermometers for)	7	...	...	7
Do. do. (chambers for)	1	...	...	1
Hodgkinson's Actinometers	2	...	...	2
Herschell's do.	1	...	...	1
Regnault's Hygrometers	3	...	...	3
Daniel's do.	10	...	...	10
Halleur's do.	5	...	...	5

Return of the Stock, Receipt and Issue of Instruments for the year 1887-88—continued.

Instruments.	In store on 1st April 1887.	Received, 1887-88.	Issued, 1887-88.	In store on 31st March 1888.
Pocket spectroscopes (Browning's)	1	...	...	1
Anemometers	25	46	28	43
Wind vanes	16	2	13	5
Beckley's anemograph	3	1	2	2
Casella's do.	2	1	...	3
Draper's self-recording Sun thermometers	1	...	1	...
Electrical anemometer and wind vanes	3	...	...	3
Rain-gauges (Symons') 5" diameter	35	110	21	124
Do. do. 6" do.	1	1	...	2
Do. do. 8" do.	1	3	1	3
Measure glasses for 5" Rain-gauge	44	148	9	183
Do. for 6" do.	1	10	1	10
Do. for 8" do.	3	1	1	3
Reading lenses	1	4	3	2
Sun thermometer stands	10	...	3	7
Radiation pads	8	...	3	5
Barometer cages . . . . .	...	1	1	...
Thermometer cages	6	...	2	4
Do. do. for ships	12	2	...	14
Prismatic compasses	1	...	...	1
Sand-glasses (3 minutes)	10	30	11	29
Sun-dials	1	...	...	1
Clocks . . . . .	...	4	4	...
Bottles for wet bulb thermometers	112	...	8	104
Electrophorous	1	...	...	1
Filled tubes for Marine K. P. barometers	8	10	6	12
Do. for Observatory K. P. barometers	17	10	...	27
Chain for Casella's embossing anemograph	100 ft.	...	...	100 ft.
Gauges for testing Symons' rain-gauges	1 pair	...	...	1 pr.
Plummet brass . . . . .	...	1	...	1
Bull's eye lanterns . . . . .	...	1	1	...

APPENDIX B.

List of Recipients of the Publications of the Meteorological Office.

Adelaide	Meteorological Observatory.
Agra	Editor of the <i>Delhi Gazette</i> .
Ajmere	Chief Commissioner.
Algeria	Meteorological Service of the Ecole des Sciences d'Alger.
	Secretary to the Government, North-Western Provinces and Oudh.
	Department of Revenue and Agriculture, North-Western Provinces and Oudh.
Allahabad	Meteorological Reporter, North-Western Provinces and Oudh.
	Sanitary Commissioner, ditto ditto.
	Editor of the <i>Pioneer</i> .
Amraoti	Sanitary Commissioner for Berar.
Amsterdam	Royal Academy of Sciences.
	Chief Commissioner, Mysore and Coorg.
Bangalore	Inspector General of Forests, Mysore and Coorg.
Batavia	Magnetical and Meteorological Observatory.
Berlin	Royal Prussian Meteorological Institute.
	Secretary to the Government of Bombay.
	Meteorological Reporter for Western India.
	Colaba Observatory.
	Sanitary Commissioner with the Government of Bombay.
	Bombay University.
Bombay	Asiatic Society of Bombay.
	Sassoon Mechanics Institute.
	Geographical Society of Bombay.
	Editor of the <i>Bombay Gazette</i> .
	Ditto <i>Times of India</i> .
	Elphinstone College.
Brisbane, Queensland	Observatory.
Brussels	Royal Academy of Sciences.
	Royal Observatory.
Bucharest, Roumania	Meteorological Institute.
Budapesth	Observatory.
	H. M. Secretary of State for India (through Revenue and Agricultural Dept.).
	Private Secretary to His Excellency the Viceroy.
	Secretary to the Government of India, Revenue and Agricultural Department.
	Ditto ditto, Home Department.
	Ditto ditto, Public Works Department.
	Ditto ditto, Foreign Department.
	Ditto ditto, Department of Finance and Commerce.
	Ditto ditto, Military Department.
	Secretary to the Government of Bengal, Revenue Department.
	Meteorological Reporter to the Government of Bengal.
	Surveyor-General of India.
	Geological Survey of India.
Calcutta	Sanitary Commissioner with the Government of India.
	Ditto to the ditto Bengal.
	Superintendent, Botanical Gardens, Calcutta.
	Inspector-General of Forests with the Government of India.
	Surgeon-General with the Government of India.
	Asiatic Society of Bengal.
	Indian Museum.
	Calcutta University.
	Presidency College.
	Public Library.
	Editor of the <i>Calcutta Review</i> .
	Ditto <i>Statesman and Friend of India</i> .

List of Recipients of the Publications of the Meteorological Office—continued.

	Editor of the <i>Englishman</i> .
	Ditto <i>Indian Daily News</i> .
	Ditto <i>Hindu Patriot</i> .
	Ditto <i>Indian Agriculturist</i> .
Calcutta—contd.	Pat. Doyle, Esq., C.E., Editor, <i>Indian Engineering</i> .
	St. Xavier's College Observatory.
	The Alipore Observatory.
	Mint Master.
	Indian Association for the Cultivation of Science.
Cambridge	University Library (through H. M.'s Secretary of State for India).
Cambridge, Massachusetts	Harvard University.
Cape of Good Hope	Astronomer Royal.
Carlsruhe, Baden, Germany	Bureau für Meteorologie und Hydrographie.
Chemnitz	Royal Meteorological Institute.
Chatham	Royal Engineers' Library.
Christiania	Norske Meteorologiske Institut.
	Royal Observatory.
	Editor of the <i>Ceylon Times</i> .
Colombo	Ditto <i>Ceylon Observer</i> .
	Surveyor-General of Ceylon.
Copenhagen	Danske Meteorologiske Institut.
	Royal Danish Academy of Sciences.
	Meteorological Office.
Cordoba	National Academy of Science
	Servicio Meteorologico de la Provincia de Cordoba.
Darjeeling	Conservator of Forests, Bengal.
Dehra Dun	Editor of the <i>Indian Forester</i> .
	Superintendent, Great Trigonometrical Survey.
Dharwar	Conservator of Forests, Bombay, Southern Division.
Dublin	Royal Dublin Society.
Dacca	Dacca College.
	Scottish Meteorological Society.
Edinburgh	Astronomer Royal for Scotland, Royal Observatory.
	Scottish Geographical Society (through H. M.'s Secretary of State for India).
	Royal Observatory.
Greenwich	Astronomer Royal, Royal Observatory.
Guatemala	Observatorio Meteorologico del Institut Nacional de Guatemala.
Hamburgh	Nord Deutsche Seewarte.
	Deutsche Meteorologische Gessellschaft.
Havana	Real Collegio de Belen.
Hong-Kong	Observatory.
Indore	Agent to the Governor General for Central India.
Iowa, U. S.	Iowa Weather Service.
Jeypore	Maharajah's Observatory.
Jubbulpore	Civil Surgeon.
Katmandu	Resident at Nepal.
Khandwa	Civil Surgeon of Nimar.
Kitzingen, Bavaria	Dr. Emil Von Schlagintweit.
Kurrachee	Conservator of Forests, Bombay, Sind Division.
	Secretary to the Government of the Punjab.
Lahore	Meteorological Reporter ditto ditto.
	Sanitary Commissioner ditto ditto.
	Conservator of Forests ditto ditto.
Leeds	Yorkshire College (through H. M.'s Secretary of State for India).
Leipzig	Geographical Society.
Lisbon	Observatoire de Infante d'Luiz.
	Academy of Sciences.
	Meteorological Council.
	Royal Society.
London	Royal Asiatic Society (through H. M.'s Secretary of State for India).
	Northbrook India Club (through H. M.'s Secretary of State for India).
	Society of Arts.
	Institution of Civil Engineers.
	Royal School of Mines.

List of Recipients of the Publications of the Meteorological Office—continued.

London— <i>contd.</i>	Royal Meteorological Society.
	Admiralty Library.
	United Service Institution.
	British Museum (through H. M.'s Secretary of State for India).
	Athenæum Club.
	Editor of the <i>Philosophical Magazine</i> .
	Ditto <i>Athenæum</i> .
	Ditto <i>Nature</i> .
	Ditto <i>Symons's Monthly Meteorological Magazine</i> .
	Ditto <i>Westminster Review</i> .
Madras	Ditto <i>Quarterly Review</i> .
	Secretary to the Government of Madras.
	Ditto ditto, Public Works Department.
	Meteorological Reporter to the Government of Madras.
	Government Astronomer, Madras.
	Sanitary Commissioner, Madras.
	Madras University.
	Editor of the <i>Madras Times</i> .
	Ditto <i>Madras Mail</i> .
	Ditto <i>Christian College Magazine</i> .
Madrid	Government Central Museum.
	Assistant Director of Agriculture, Government of Madras.
	Surgeon-General, British Medical Department.
	Ditto, Indian Medical Department.
	Port Officer of Madras.
	Conservator of Forests, Northern Circle.
	Ditto ditto Southern Circle.
	Royal Observatory.
	Observatory of the Magdeburg Zeitung.
	Literary and Philosophical Society.
Manchester	Meteorological Observatory.
Manila	Meteorological Society.
Mauritius	Observatory.
Melbourne, Victoria	University Library.
	Public Library.
	Central Meteorological Observatory.
Mexico	Royal Astronomical Observatory.
Milan	Royal Observatory.
Munich	Royal Bavarian Academy of Sciences.
	Geographical Society.
	Royal Bavarian Meteorological Central Station.
	Chief Commissioner, Central Provinces.
Nagpur	Sanitary Commissioner, ditto.
	Inspector-General of Education, Central Provinces.
	Meteorological Observatory.
	Conservator of Forests, Central Provinces.
Naini Tal	Ditto ditto Central Circle, North-Western Provinces and Oudh.
New Haven, Connecticut	Connecticut Academy of Arts and Science.
	Editors of the <i>American Journal of Science</i> .
New York, U. S.	Meteorological Observatory.
Ootacamund	Editor of the <i>South of India Observer</i> .
Oxford	Radcliffe Library.
	Radcliffe Observatory.
	Observatoire Municipal de Montsouris.
Paris	Editor of <i>La Nature</i> .
	Physical Observatory, Meudon.
	Bureau Central Météorologique de France.
	Meteorological Society of France.
Perpignan, France	Observatoire Météorologique et Magnétique.
Perth, W. Australia	Meteorological Reporter.
Pesaro, Italy	Royal Observatory.
Philadelphia	Franklin Institute.
Poona	Conservator of Forests, Northern Circle, Bombay Presidency.
Prague, Bohemia	K. K. Sternwarte.

List of Recipients of the Publications of the Meteorological Office—concluded.

Raipur	Civil Surgeon.
Rangoon	Chief Commissioner, Burma.
	Sanitary Commissioner, ditto.
	Conservator of Forests, ditto.
	Editor of the <i>Rangoon Times</i> .
Rome	Central Meteorological Office.
Rio de Janeiro	Imperial Observatory.
Saharunpore	Superintendent, Botanic Gardens.
Santiago	Observatorio Nacional.
Secunderabad	Secretary to the Resident at Hyderabad.
Shillong	Chief Commissioner of Assam.
	Conservator of Forests, Assam.
Simla	Assistant Quarter Master General, Intelligence Branch.
Singapore	Principal Civil Medical Officer, Straits Settlements.
Stockholm	Nautisk Meteorologiska Byran.
St. Petersburg	Physical Central Observatory.
	Imperial Geographical Society of Russia.
	Prof. H. Wild, Physical Central Observatory.
Strasburg	Imperial University Library.
Stonyhurst	Stonyhurst College Observatory.
Sydney	Observatory.
	University Library.
Syracuse, Sicily	Royal Meteorological Observatory.
Tasmania	Royal Society.
Tiflis, Russia	Physical Observatory.
Tokei, Japan	Imperial Mining Office.
	Imperial Meteorological Observatory.
Toronto, Canada	Meteorological Office.
Turin	Royal Astronomical Observatory.
	Meteorological Society of Italy.
Upsala	Meteorological Observatory.
Utrecht	Royal Netherlands Meteorological Institute.
Vienna	K.K. Central-Anstalt für Meteorologie und Erdmagnetismus.
	K.K. Geologische Reichsanstalt.
	Imperial Academy of Sciences.
	Dr. J. Hann.
Vizagapatam	A. V. Nursingrow, Esquire.
	Chief Signal Officer, United States Army.
	Smithsonian Institution.
	United States Naval Observatory.
Washington, U. S.	Hydrographic Office.
	Professor Cleveland Abbe.
	United States Geological Survey.
Wellington, New Zealand	Observatory.
Woolwich	Royal Artillery Library.
Zi-ka-wei, Shanghai	Magnetical and Meteorological Observatory.
Zurich	Central Meteorological Institute.

APPENDIX C.

Presentations to the Library from the 1st April 1887 to the 31st March 1888.

Place.	Donors.	Title of Work.
ALGERIA . . .	Meteorological Service . . .	{ Bulletin Météorologique du Gouvernemen: général de l'Algérie, 1st March 1887 to 31st January 1888. Bulletin Mensuel, August 1886 to March 1887. Observations Météorologiques du Réseau Africain, Année 1883.
ALLAHABAD . . .	{ Government of the N.-W. Prov- inces and Oudh. Meteorological Office . . . S. A. Hill, Esq.	{ Gazetteer of the N.-W. Provinces, Vols. I to XIV. Gazetteer of the Province of Oudh, Vols. I to III. Supplement to the Fatchpur Gazetteer. Administration Report of the Meteorological Reporter to the Government of the N.-W. Provinces and Oudh for the year 1886-87. Some anomalies in the winds of Northern India and their relation to the distribution of barometric pressure.
AMSTERDAM . . .	Royal Academy of Sciences . . .	{ Jaarboek voor 1885. Verslagen en Mededeelingen der Koninklijke Akademie van Wetenschappen, Afd Natuurkunde, Derde Reeks, Deel II.
BATAVIA . . .	Magnetical and Meteorological Observatory.	{ Rainfall in the East Indian Archipelago, 1886. Observations made at the Magnetical and Meteorological Observatory at Batavia, Vol IX.
BERLIN . . .	{ German and Austrian Meteorologi- cal Society. K. Preussischen Meteorologischen Institut.	{ Meteorologische Zeitschrift, March to December 1887. Ergebnisse der Meteorologischen Beobachtungen im Jahre 1886.
BERNE . . .	Dept. de l'intérieur de la Confé- dération Suisse.	{ Tableau graphique des observations hydrométriques suisses pour le Rhin, Aar, Tessin, Rhone, Limmat, and Ruess, July 1886 to June 1887.
BLUE HILL (U. S. A.)	A. Lawrence Rotch . . .	{ Results of the Meteorological observations made at the Blue Hill Meteorological Observatory in the year 1886.
BOMBAY . . . 4	{ Government of Bombay . . . Government Observatory . . . Meteorological Office . . .	{ Twenty-third Annual Report of the Sanitary Commissioner for the Govern- ment of Bombay for 1886. Magnetical and Meteorological observations made at the Government Obser- vatory, Bombay, for 1885. Brief sketch of the Meteorology of the Bombay Presidency in 1886-87.
BRISBANE . . .	Meteorological Observatory	{ Meteorological synopsis of the Brisbane Observatory for January to July 1887. Rainfall summaries taken at stations in the Colony of Queensland during January to June 1887. Correspondence relating to Meteorological Inspection and proposals for a new meteorological organization in the Colony of Queensland. Weather chart of Australasia at 9 A.M., 3rd September 1887 to 9th February 1888 (Sundays and holidays excepted).
BRUSSELS . . .	Royal Academy of Sciences . . .	{ Annuaire, 1886 and 1887. Bulletin, 3rd series, Tomes IX to XIII.
BUDAPESTH . . .	Central Anstalt für Meteorologie- und Erdmagnetismus. Comptroller and Auditor General .	{ Jahrbucher, XV Band, Jahrgang 1885. Civil Estimates 1887-88, Vols. I and II.
CALCUTTA . . .	{ Consul General of France . . . Geological Survey of India . . .	{ Compté Rendu des seances de la Commission Centrale des Société de geo- graphie de France. Memoirs, Vol. XXIV, Part I. Records, Vol. XX, Parts 2 to 4, and Vol. XXI, Part I. Manual of the Geology of India, Part IV.

Presentation to the Library from the 1st April 1887 to the 31st March 1888—continued.

Place.	Donors.	Title of Work.
CALCUTTA	Government of Bengal.	Returns of the Rail-borne Traffic of Bengal during the quarters ending the 31st December 1886, 31st March, 30th June, and 30th September 1887, and for the year 1886-87.
		Report on the external Trade of Bengal with Nepal, Thibet, Sikkim, and Bhutan for the year 1886-87.
		Report on the River-borne Traffic of the Lower Provinces of Bengal and on the Inland Trade of Calcutta and on the Trade of Chittagong and the Orissa ports, with notes on Road Traffic for 1886-87.
	Government of India, Home Department.	Report of the Meteorological Council of the Royal Society for the year ending 31st March 1886.
		Instructions for keeping Log Books and compiling Meteorological Returns issued by the Bureau of Navigation, Navy Department, United States, America.
		India Office List for 1886.
	Government of India, Revenue and Agricultural Department.	Variations of the Prices of Staple Food-grains in the Bombay Presidency by F. Chambers, Meteorological Reporter for Western India.
		Hand-book of Stations on Indian Railways corrected up to 31st December 1886.
		Report on the condition and proceedings of the Government Observatory, Colaba, for the year which ended with the 30th June 1887.
		Administration Report of the Indian Marine for 1886-87.
		List of Civil Officers holding Gazetted Appointments under the Government of India in the Home, Legislative, Foreign, and Revenue and Agricultural Departments corrected to 1st July 1887.
		Administration Report upon the Madras Observatory for the year 1886.
		Civil Travelling Allowance Code, Revised Edition, Chapters 1 to 15 only (Provisional Issue).
		Imperial Gazetteer of India, 2nd Edition, Vols. XII, XIII and XIV.
		Report of the Public Service Commission, 1886-87, with Appendices and Proceedings of the Sub-Committee.
		Proceedings of the Public Service Commission, Vols. I to VI.
	Henry F. Blanford, Esq.	Report on the preparations for, and observations of, the Transit of Venus, as seen at Roorkee and Lahore on the 8th December 1874.
	Indian Association for the Cultivation of Science.	Report of the Tenth Annual Meeting held in April 1887.
	Inspector General of Forests.	Report on the Course of Instruction at the Forest School, Dehra, for the year 1886-87.
	Meteorological Office, Bengal	Report on the Administration of Bengal for 1885-86.
	Pat. Doyle, Esq.	Indian Engineering, Vol. III, Nos. 9 to 13.
	Public Library	Report of the Calcutta Public Library for 1887, with Appendices.
	S. R. Elson, Esq.	Memoranda of Useful Information for Shipmasters.
		Changes observed in the Density of the surface Sea-water at the Sandheads.
CAPE OF GOOD HOPE	Sanitary Commissioner with the Government of India.	Twenty-second and Twenty-third Annual Report of the Sanitary Commissioner with the Government of India for the years 1885 and 1886.
	Surveyor-General of India	General Report on the Operations of the Survey of India Department during 1885-86.
CARLSRUHE	Telegraph Department	Indian Telegraph Guide, No. XXXIV.
	W. R. Williams	Pilot's Pocket Book for 1887.
CHEMNITZ	Meteorological Commission	Report of the Meteorological Commission for the year 1886.
		Beiträge zur Hydrographie des Grossherzogthums, Baden, Erster Heft.
CARLSRUHE	Central Bureau für Meteorologie und Hydrographie.	Jahres-Bericht für das Jahr. 1886.
		Resultate aus den meteorologischen Beobachtungen im Jahre 1864 to 1873.
CHEMNITZ	Royal Meteorological Institute	Jahrbuch für 1886, 1. Lieferung, Abth 1 and 2.

Presentations to the Library from the 1st April 1887 to the 31st March 1888.

Place.	Donors.	Title of Work.
CHRISTIANIA . . .	Norwegian Meteorological Institute.	Beobachtungs-Ergebnisse der Norwigischen Polarstation Bossekop in Alten, Theil I. Jahrbuch für 1886,
COLOMBO . . .	Surveyor-General of Ceylon . . .	Administration Report, 1886, Part II, Scientific, Meteorology.
COPENHAGEN . . .	Institut Meteorologique Danois . . .	Bulletin Meteorologique du Nord, February 1887 to January 1888. Annuaire Météorologique pour l'année 1884, Part II, and 1885, Parts I and III.
	Royal Academy of Sciences . . .	Oversigt, No. 3 of 1886, and Nos. 1 and 2 of 1887.
	Meteorological Office . . .	La Variabilidad interdiurna de la Temperatura en algunos puntos de la Republica Argentina y de America del sur en general, No. IV. Anales de la oficina Meteorologica Argentina, Tome V.
CORDOBA . . .	National Academy of Sciences . . .	Boletin de la Academia Nacional Ciencias, Tomo. IX, Entregas 1, 2, 3a and 4a, Tomo X, Entrega 1. Actas de la Academia Nacional de Ciencias en Cordoba (Republica Argentina), Tome V, Entrega Tercera.
DEHRA DUN . . .	Editor	"Indian Forester", April 1887 to March 1888.
	Trigonometrical Branch, Survey of India.	Synopsis of the Results of the Operations of the Great Trigonometrical Survey of India, Vol. VIII A. Spirit-levelled heights No. 2, Madras Presidency, Season 1885-86.
	Dr. Karl Wehhranch	Einfluss des Widerstandes auf die Pendelbewegung bei ablenkenden Kräften mit Anwendung auf des Foucault'sche Pendel. Zwanzigjährige Mittelwerthe aus den Meteorologischen Beobachtungen 1886 bis 1885 für Dorpat.
DORPAT . . .	Observatory	Observations, September 1886 to September 1888. Bericht über die Ergebnisse der Beobachtungen an den Regenstation für das Jahr. 1886.
DUBLIN . . .	Royal Dublin Society	Scientific Proceedings, Vol. V, New Series, Parts 3 to 6. Scientific Transactions, Vol. III, Series II, Nos. 11 to 13.
EDINBURGH . . .	Scottish Meteorological Society . . .	Journal, 3rd Series, No. 4.
GREENWICH . . .	Royal Observatory	Results of Meteorological and Magnetical Observations made at the Royal Observatory, Greenwich, in the year 1885. Wetterbericht, 1st March 1887 to 29th February 1888. Monatsbericht, January 1886 to September 1887.
HAMBURGH . . .	Deutsche Seewarte	Die Ergebnisse der Witterprognosen im Jahre 1886. Meteorologische Beobachtungen in Deutschland Jahrg VIII, 1885. Deutsche Ueberseeische Meteorologische Beobachtungen, Heft I.
HAVANNA . . .	Real Colegio de Belen	Observaciones Magneticas y Meteorologicas, October to December 1885. Five-day means of the principal Meteorological Elements for 1886. Annual Weather Report for 1886.
HONG-KONG . . .	Observatory	Weather Report for January to October 1887. Observations and Researches made at the Hong-Kong Observatory in 1886. Report on Information issued in 1886 concerning Typhoons.
IOWA . . .	Dr. Gustavus Henrichs	Report of the Iowa Weather Service for 1886.
JEYPORE . . .	Maharajah's Observatory	Annual Reports of the Jeypore Medical and Meteorological Institutions for 1886 and 1887.
LAHORE . . .	Government of the Punjab	Report on the Meteorology of the Punjab for the year 1886-87.
	Meteorological Office	Summary of Meteorological Conditions prevailing over the Punjab during March 1887 to February 1888.
LEIPZIG . . .	Vereins für Erdkunde	Mittheilungen des Vereins für Erdkunde zu Leipzig, 1884, 1885 and 1886.

Presentations to the Library from the 1st April 1887 to the 31st March 1888—continued.

Place.	Donors.	Title of Work.
LISBON . . .	Royal Academy of Sciences . . .	Conferencia Acerca dos Infinitamente Pequenos.
		Conferencia Acerca da Circulacao da Materia.
		Jornal de Sciencias Mathematicas Physicas e Naturaes, Nos. XXX to XLIV.
	G. J. Symons, Esq. . . .	Symons's Monthly Meteorological Magazine, March 1887 to February 1888.
		Quarterly Weather Report, Parts II to IV of 1878, and Parts I and II of 1879.
		Monthly Weather Report, September to December 1885.
		Weekly Weather Report, Vol. III, No. 53; Vol. IV, Nos. 1 to 55.
		Quarterly summary of the weekly Weather Report, Vol. III, 4th quarter and year; Vol. IV, 1st and 2nd quarters.
		Report of the third meeting of the International Meteorological Committee, held at Paris, September 1885.
		Report of the Meteorological Council to the Royal Society for the year ending 31st March 1886.
LONDON . . .	Meteorological Office . . .	Hourly Readings, Parts III and IV of 1884 and Part I of 1885.
		Daily Weather Report, 1st July to 31st December 1886.
		Atlantic Weather Charts, 8th November 1882 to 14th February 1883.
		Suggestions for an international nomenclature of clouds and remarks concerning the nomenclature of clouds.
		Meteorological observations made in ships of the Russian Fleet (Nos. 52 to 54).
	Publishers	Westminster Review, January to March 1888.
	Royal Asiatic Society . . .	Journal, Vol. XIX, Parts II to IV; Vol. XX, Part I.
	Royal Meteorological Society . . .	Quarterly Journal, Vol. XIII, Nos. 61 to 64.
		Hints to Meteorological Observers.
		Meteorological Record, Vol. VI, Nos. 23 to 26.
MADRAS . . .	Royal Society	Proceedings, Nos. 249 to 260.
	Society of Arts	Journal, Nos. 1791 to 1842.
	Government Astronomer . . .	Results of the observations of the fixed Stars made with the meridian circle at the Government Observatory, Madras, for the years 1862 to 1864.
	Government of Madras . . .	Manuals of the Kurnool and Coimbatore districts of the Malabar district, Vols. I and II.
		Annual Administration Report of the Forest Department, Madras Presidency, for the year 1885-86.
		Observaciones meteorológicas efectuadas en el Real observatorio de Madrid, Anos 1865, 1866 and 1868 to 1875.
		Jahrbuch der meteorologischen Beobachtungen, Jahrg IV, 1885.
		Observaciones verificados, January to June 1883.
		Annual Report of the Director of the Royal Alfred Observatory for the year 1886.
		Mauritius Meteorological Results for 1886.
MADRID . . .	Astronomical Observatory . . .	Monthly record of results of observations in Meteorology, Terrestrial Magnetism, &c., taken at the Melbourne Observatory from October 1886 to October 1887.
MAGDEBURGH . . .	Magdeburgischen Zeitung . . .	Longitud del Observatorio Astronomico Nacional Mexicana.
MANILA . . .	Meteorological Observatory . . .	Anuarie Ano de 1888.
MAURITIUS . . .	Observatory	Publicazioni del Reale Osservatorio di Brera in Milano, No. 6; No. 7, Part II; and Nos. 27 to 31.
MELBOURNE . . .	Observatory	Nuova triangolazioni della citta di Milano.
MEXICO . . .	Observatory	Osservazioni Meteorologiche eseguite nella R. Specola di Brera Annos 1882 and 1887.
MILAN . . .	R. Osservatorio Astronomico . . .	

Presentations to the Library from the 1st April 1887 to the 31st March 1888—continued.

Place.	Donors.	Title of Work.
MUNICH . . .	Geographical Society	Jahresbericht der Geographischen Gesellschaft für 1886.
	Meteorological Central Station . . .	Übersicht über die Witterungsverhältnisse im Königreiche Bayern, June to August 1886 and February 1887 to January 1888.
		Beobachtungen der Meteorologischen stationen im Königreich Bayern, Jahrgang, VIII, hefte 2 and 4, Jahrgang IX, hefte 1 to 3.
	Royal Bavarian Academy of Sciences.	Sitzungsberichte der mathematisch-physicalischen classe 1885, hefts 2 to 4; 1886, hefts 1 to 3.
		Abhandlungen der mathematisch-physicalischen, Fünfzehnter Band, Diette and Twiete Abth; Schzehnter Band, Erste Abth.
Gedächtnisrede auf Joseph von Fraunhofer zur Feier Seines hundertsten Geburtstags.		
NAGPUR . . .	Chief Commissioner, Central Provinces.	Gedächtnisrede auf Carl Theodor v Siebddd.
		Inhaltsuerzeichniss der Sitzungsberichte, Jahrgang 1871 to 1885.
		Resolution on the Revenue Administration of the Central Provinces for the years 1885-86 and 1886-87.
	Sanitary Commissioner, Central Provinces.	Resolution on the management by Government of private Estates in the Central Provinces during the year ending 30th September 1886.
		Returns of Railway-borne Traffic for the quarters ending 31st March, 30th June, and 30th September 1887, and for the year 1886-87.
NEW HAVEN . . .	Connecticut Academy of Arts and Sciences.	Report on the Nagpur Experimental Farm in the Central Provinces for 1886-87.
		Report of the Sanitary Commissioner, Central Provinces, for the years 1873 to 1885.
	Yale University	Transactions, Vol. VII, Part I.
NEW YORK . . .	Observatory	Transactions of the Astronomical Observatory of Yale University, Vol. I, Part I.
OXFORD . . .	Radcliffe Observatory	Abstract of registers from Self-recording Instruments for January to December 1887.
PARIS . . .	Bureau Central Météorologique de France.	Results of Meteorological Observations made at the Radcliffe Observatory in the year 1884.
		Bulletin International, 4th March 1887 to 1st March 1888.
	Meteorological Society of France	Bulletin Mensuel, January to November 1887.
PHILADELPHIA . . .	Franklin Institute.	Annuaire November 1886 to September 1887.
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		Magnetische und Meteorologische Beobachtungen im Jahre 1886.
RIO DE JANEIRO . . .	K. W. Zenzie	Die Meteorologie Sonne und die Wetter Prognose des Jahres 1886.
		Revista do observatorio, February 1887 to January 1888.
RIPOSTO . . .	Imperial Observatory	Bulletin Astronomique et Meteorologique, December 1883.
ROME . . .	Osservatorio Meteorologico del R. Istituto Nautico.	Bullettino mensile, February 1887 to January 1888.
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SINLANGOR (Malay States).	C. E. Peek, Esq.	Meteorological Observations made at the Rousdon Observatory for 1886.
	A. W. Sinclair, Esq.	Meteorological Observations made in Sinlangor (Malay States), 1879 to 1884.

Presentations to the Library from the 1st April 1887 to the 31st March 1888—continued.

Place.	Donors.	Title of Work.
ST. PETERSBURGH .	Imperial Russian Geographical Society.	Beobachtungen der Russischen Polarstation an der Leinamundung, II Theil.
		Meteorologische Beobachtungen, I and II Zeiferung.
		Beobachtungen vom Jahre 1882-83 and 1883-84.
		Beobachtungen der Russischen Polarstation auf Nawajozemlia, II Theil.
		Meteorologische Beobachtungen bearbeitet von K. Andryeff.
		Heransgegeben unter Reduction von R. Lenz.
	Physical Central Observatory	Annalen des Physicalischen Central Observatoriums Jahrg 1885.
		Jahresbericht des Physicalischen Central Observatoriums 1869, 1873-74, 1877-78, 1879-80, 1881-82, and 1883-84.
		Correspondence Meteorologique publication trimestrielle del' administration des mines de Russie Année 1850 to 1864.
		Compte Rende Annuel 1849, 1850 and 1852 to 1864.
		Meteorologisches Daily Bulletin 1878 to 1884.
STONYHURST . . .	College Observatory . . .	Ueber Auf und Zugang der Gewässer des Russischen Reiches von Rykatschen.
		Wahre Tagesmittel und tagliche variation der Temperatur an 18 stationen des Russischen Reiches von Wahlen.
SYDNEY . . .	H. C. Russell . . .	Catolog der Meteorologischen stationen in Russland und Finland von Leyst.
		Pegen Verhältnisse des Russischen Reiches, mit Atlas.
SYDNEY . . .	Observatory . . .	Results of Meteorological and Magnetical Observations, 1886.
		Notes upon floods in Lake George.
SYDNEY . . .	Observatory . . .	Notes upon the history of floods in the river Darling.
		Results of rain and river observations made in New South Wales and part of Queensland during 1886.
SYRACUSE . . .	Observatory . . .	Results of Meteorological Observations made in New South Wales during 1885.
TASMANIA . . .	Royal Society . . .	Osservazioni Meteorologiche Anno X, Nos. 1 to 12.
TIFLIS . . .	Physical Observatory . . .	Papers and Proceedings of the Royal Society of Tasmania for 1886.
TOKIO . . .	Imperial Meteorological Central Observatory.	Meteorologische Beobachtungen im Jahre 1885.
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TORONTO . . .	Meteorological Office . . .	Monthly summaries and monthly means for the year 1886, with 41 maps.
TURIN . . .	Dr. L. Camerans . . .	Monthly Weather Review, December 1886 to December 1887.
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		Ricerche interno alle specie Italiane del Genere Gordins.
		A. Charier.—Bollettino dell' Osservatorio, Anno XXI, 1886.
		A. Charier.—Effemeridi del sole, della Luna e dei principali Pianeti calcolati per Torino in tempo medio civile di Roma per l' anno 1888.
	Osservatorio Astronomico dell' Università di Torino.	F. Porro.—Osservazioni delle Comete Finlay e Barnard-Hartwig all' equatoriale di Merz.
		F. Porro.—Nuove osservazione delle Comete Finlay e Barnard-Hartwig all' equatoriale di Merz.
		F. Porro.—Determinazione della latitudine della stazione astronomica di Termoli mediante passaggidi stelle al primo verticale.
		F. Porro.—Terza ed ultima serie di osservazioni delle Comete Finlay e Barnard-Hartwig all' equatoriale di Merz.
		Bollettino Mensuale, January to December 1887.
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Presentations to the Library from the 1st April 1887 to the 31st March 1888—continued.

Place.	Donors.	Title of Work.
TURIN	Societa Meteorologica Italiana	<p>Bollettino mensile, Serie II, Vols. I—III, Vol. V, No. 2; Vol. VIII, No. 1.</p> <p>Bollettino decadico, Anno XIII, Nos. 1 and 2.</p>
UMBALLA	G. T. Carruthers	Sun's Great Waterfall.
UPSALA	Meteorological Observatory	Bulletin mensuel, Vol. XVIII, Année 1886.
UTRECHT	Royal Dutch Meteorological Institute.	Nederlandsch Meteorologisch Jaarboek voor 1878, Tweede Deel 1886.
	Dr. K. Exner	Ueber die Scintillation.
	K. K. Central Anstalt für Meteorologie und Erdmagnetismus.	<p>Wetterbericht, 21st January 1887 to 10th February 1888.</p> <p>Jahrbucher, Jahrgang 1885, Band XXII.</p> <p>Meteorologische Zeitschrift, January 1888.</p>
	K. K. Geologische Reichsanstalt	<p>Verhandlungen, Nos. 2 to 18 of 1887; No. 1 of 1888.</p> <p>Dr. A. Wossmuth und Dr. G. A. Schilling.—Über eine experimentelle Bestimmung der Magnetisirungsarbeit.</p> <p>Dr. C. W. C. Fuchs.—Statistik der Erdbeben von 1865 to 1885.</p> <p>Dr. Eduard Mahler.—Astronomische Untersuchungen über in hebräischen Schriften erwähnte Finsternisse.</p> <p>Untersuchung einer im Buche, "Nahum" auf den Untergang Ninive's bezogenen Finsterniss.</p> <p>Über den Stern misri der Assyrier.</p> <p>Über eine in einer syrischen Grabinschrift erwähnte Sonnenfinsterniss.</p> <p>Dr. Robert Schram.—Beitrag zur Hansen'schen Theorie der Sonnenfinsternisse.</p> <p>Friedrich Bidschof.—Bestimmung der Bahn des Planeten 236 Honoria.</p> <p>Bestimmung der Bahn des Kometen 1848 I.</p> <p>Dr. A. V. Wallenhofen.—Über die Thermen von Gastein.</p> <p>Dr. Gottlieb Adler.—Über die Energie magnetisch polarisirter Körper, nebst Anwendungen der bezüglichen Formeln insbesondere auf Quincke's Methode zur Bestimmung der Diamagnetisirungszahl.</p> <p>J. Hanbner.—Über die Linein gleicher Stromdichte auf flächenförmigen Leitern.</p>
VIENNA	Royal Academy of Sciences	<p>Dr. Max Schuster.—Resultate der Untersuchung des nach dem Schlamregen von 14 October 1885 in Klagenfurt gesammelten Staubes.</p> <p>J. Lisnar.—Über den Stand des Normalbarometers des meteorologischen Institutes in Wien gegenüber den Normalbarometern der anderen meteorologischen Centralstellen Europä's.</p> <p>Über die 26tägige Periode der erdmagnetischen Elemente in hohen magnetischen Breiten.</p> <p>Über die 26tägige Periode der täglichen Schwankung der erdmagnetischen Elemente.</p> <p>G. V. Niesel.—Bahnbestimmung des Meteors vom 17. Juni 1885.</p> <p>Dr. Franz Kühnert.—Über die definitiven Elemente des Planeten 153 Hilda.</p> <p>Fras Exner.—Über die Ursache und die Gesetze der atmosphärischen Elektrizität.</p> <p>Zur Photometrie der Sonne.</p> <p>Über Transportable Apparate zur Beobachtung der atmosphärischen Elektrizität.</p> <p>A. V. Obermayer u. M. Ritter v. Pichler.—Über die Einwirkung der Entladung hochgespannter Elektrizität auf feste in Luft suspendirte Theilchen.</p> <p>Über die Entladung hochgespannter Elektrizität aus Spitzen.</p> <p>Anton Lampel.—Über Drehschwingungen einer Kugel mit Luftwiderstand.</p>

Presentations to the Library from the 1st April 1887 to the 31st March 1888—concluded.

Place.	Donors.	Title of Work.
VIENNA—continued	Royal Academy of Sciences—continued.	<i>J. Loschmidt</i> .—Schwingungszahlen einer elastischen Hohlkugel.
		<i>Theodor Ritter v Oppolzer</i> .—Bahnbestimmung des Planeten 237 Cölestina.
		<i>Eduard Linnemann</i> .—Austrium, ein neues metallisches Element.
		<i>J. Hann</i> .—Bemerkungen zur täglichen Oscillation des Barometers.
		<i>Boltzman</i> .—Neuer Beweis zweier Sätze über das Wärmegleichgewicht unter mehratomigen Gasmolekülen.
		<i>Eduard Suess</i> .—Über unterbrochene Gebirgsfaltung.
		<i>A. Wachlowski</i> .—Die Hängelverhältnisse in der Bukowina.
		<i>Constantin Freih v Ettingshausen</i> .—Beiträge zur Kenntniss der Tertiärflora Australiens, II folge.
		<i>C. A. Porges</i> .—Über eine Inductionserscheinung.
		<i>Ladislaus Satke</i> .—Über den täglichen Gang der Windgeschwindigkeit und der Windrichtung in Tarnopol.
		<i>J. Puluj</i> .—Objective Darstellung der wahren Gestalt einer schwingenden Saite.
		<i>E. Lechner</i> .—Über Edlund's Disjunctionsströme.
		<i>V. Laska</i> .—Studien zur Störungstheorie.
		Anzieger, Nos. 24 of 1885 to 21 of 1886.
VIZAGAPATAM . . .	A. V. Nursingrow, Esq. . . .	Results of Meteorological Observations recorded at the G. V. Juggarow's Observatory, Vizagpatam, during 1886.
WASHINGTON . . .	Chief Signal Office . . .	Monthly Weather Review of the United States, December 1886 to August and October to December 1887.
		Summary and Review of International Meteorological Observations for December 1885 to September and November and December 1886.
		Weather Charts of the United States for 7 A.M., 1st August 1887 to 17th September and 25th September to 11th February 1888.
		Weather Charts of the United States for 7 A.M., 3 P.M., and 10 P.M., for 1st January to 31st March 1887.
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		Report of the Chief Signal Office, War Department, 1885, Parts I and II, 1887.
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		West Indian Hurricanes and the law of Storms.
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WELLINGTON . . .	Colonial Museum	Official record of the New Zealand Industrial Exhibition 1885.
ZI-KA-WEI . . .	Observatory	L'inclinaison des vents sur l'horizon 3e, Note premiere, Année d'observations, 1886.
		Bulletin Mensuel, January to December 1886, and year.
		Sur les variations de temperature observee's dans les cyclones, 2e Note.
ZURICH . . .	Swiss Meteorological Institute .	Meteorologische Beobachtungen, October 1886 to July 1887.
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 Examples on Heat and Electricity. By Turner.
 Geometrical Optics. By R. S. Heath.
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 Mathematical Theory of Elasticity. By Ibbetson.
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 Philosophical Magazine, March 1887 to March 1888.
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 Practical Electricity. By Ayrton.
 Properties of Matter. By P. G. Tait.
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REPORT
ON
THE ADMINISTRATION
OF THE
METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA
IN
1888-89.

PART I.—GENERAL.

The Report is divided into two parts or sections. The first gives an account of the more important changes in the working of the Department, and of the results of the more important sections of the work of the Department throughout the year. The second part contains details of administration, and describes the classification, condition and working of the observatories and meteorological offices, and the results of the inspection of observatories during the year.

2. The permanent Head of the Department, Mr. H. F. Blanford, was on furlough during the whole of the year, and I continued to act for him, and Mr. Pedler to officiate as Meteorological Reporter to the Government of Bengal. As stated in last year's Report, the Government of India, acting on a recommendation of the Finance Commission, reduced the Western India Reportership from a whole-time to half-time post from 1st August. Mr. Chambers declined to accept the appointment on the new terms, and his Head Clerk carried on the work of the Bombay Office from that date until the 7th of November, when Mr. S. A. Hutchinson of the India Telegraph Department was appointed tentatively for a period of four months. As it was found that the meteorological duties did not interfere with the proper performance of his departmental duties, he was permanently appointed Reporter for Western India on the 4th May 1889. Mr. Dallas, 1st Assistant Meteorological Reporter, took three months' privilege leave from the 28th December. Finally, Mr. Hill, Reporter to the Government of the North-Western Provinces, went on furlough for 9 months from the 3rd of March, and Mr. J. Holt, C.S., Acting Professor of Physics, Muir College, was appointed to officiate for him. There have hence been an unusually large number of changes during the past year. These have, to some extent, interfered with the full working of the Department during the last five months of the year and delayed the completion of important investigations in the Central Office.

IMPORTANT CHANGES EFFECTED DURING THE YEAR.

3. It was stated in last year's Report that the Government of India asked me in May 1887 to submit proposals for a partial reorganization of the Department, the main object

of which was to extend its practical value as a centre for collecting and disseminating meteorological data and information without sacrificing or impairing the scientific work carried on by the Department in the investigation of the causes and relations of meteorological phenomena in India. A portion of the changes proposed was sanctioned as a tentative measure in December 1888, as explained in last year's Administration Report, pages 1—9. As these changes were found to work smoothly and to increase the efficiency of the Department in the direction indicated by the Government of India, I submitted in September the final proposals for the permanent changes. These were sanctioned with effect from the 1st of January 1889. The objects and scope of these changes were fully stated in last year's Administration Report and need not be repeated. It is hence only necessary to state and explain the changes which were thus permanently introduced from 1st January 1889. This is done in the following twelve paragraphs:—

4 (1).—*The permanent retention of 8 A.M. as the hour for the observations telegraphed daily to Simla, Calcutta, and Bombay for the various Daily Weather Reports issued by the Department, and the discontinuance of the 10 A.M. and 4 P.M. observations at 88 of the 157 observatories maintained by the Department.*—The change of the general hour of the morning observations from 10 A.M. to 8 A.M. enables the Simla Office to issue the Daily Weather Report in the afternoon of the same day, and the Bengal Reporter to issue the Bay of Bengal Report at about 11 A.M. or at the beginning of the office day to Calcutta merchants, shippers, &c. The acceleration in the publication of the Daily Reports was much appreciated in Calcutta and Bombay as well as by the Government of India and the continuance of the 8 A.M. observations was hence practically decided. In my original proposals, I suggested the abolition of the 10 A.M. observations entirely, but General Strachey and Mr. Blanford both recorded their opinion that this was probably too sweeping a change. Further consideration suggested a compromise which will entirely obviate the objections that were originally urged by these meteorological authorities. The chief use made by Mr. Blanford of the daily observations at 10 A.M. and 4 P.M. was in the preparation of the monthly means and data used as the basis for the discussion contained in the Annual Report. The Simla Daily Report was a later feature of the work of the Department than the Annual Reports, and hence considered as subsidiary and less important. The Annual Reports contain comparisons of the mean values of the elements of meteorological observation for each month of the year (based on the 10 and 16 hours' observations) with the normal values. It has been frequently pointed out in annual and other reports of the Department that the variations in the elements of observation (obtained by these comparisons) accompanying large differences in the distribution of the south-west monsoon and cold weather rainfall are always small in amount. Hence accurate comparison requires not only accurate present observations, but also accurate means or accurate observations for a series of years past. It is hence undoubtedly desirable to continue to record the 10 and 16-hour observations at all observatories at which thoroughly reliable series of observations have been taken for at least 10 years. Such observatories will supply the most exact data possible under present conditions for the comparison of the meteorological conditions of the current year or of any portion of it with the normal conditions. Hitherto the observations taken at all the observatories (with the exception of certain observatories in Bengal established in 1883 for purely provincial purposes) have been included in the Annual Reports, and practically equal values or

weights have been given to all such observations, and the results based on them. A careful examination of the whole of the meteorological returns of the 157 stations at which observations were taken in 1887 has shown that those of about 88 were either vitiated by frequent errors due to carelessness of observation, or to the prolonged use of imperfect instruments or instruments whose errors were either not known or were variable in amount, or were of little value as they had not been taken for a period long enough to furnish satisfactory and comparative means. The shortest period of observation in India which will furnish fairly satisfactory and accurate mean is 10 or 11 years. Hence, as the previous observations of those 88 stations did not afford satisfactory data and means for the accurate comparison on which the scientific discussion of the weather of the year in the Annual Report is based, it was decided to discontinue the 10 and 16 hours' observations at these stations, and to continue these observations only at the remaining 69 stations, the meteorological returns of which can be accepted as of the highest standard of accuracy, and can hence be used as a reliable basis for scientific discussion in the Annual Report.

5. The continuation of the publication of the Annual Report, based on the meteorological returns of these 69 observatories, instead of on the returns of the whole 157 stations, will have the following advantages :—

1st.—The Annual Report will be published in the same form as hitherto, and meteorologists will have the continuous series of observations and means up to date for any investigation on Indian meteorology they may desire to make.

2nd.—The Annual Report will be confined to a scientific discussion and correlation of the chief features of the meteorology of the year, based on the comparison of accurate observations with accurate means, and will be of greater scientific value than at present.

3rd.—The Report will give the results of about 69 stations, instead of 142 as in that of the year 1888, and will be considerably less than half its present size. The labour of preparing and printing will hence be much diminished, and the Report will usually be issued within four or five months after the termination of the year to which it refers.

6. In consequence of these changes in the hours and work of observation at the majority of our observatories, it was necessary to re-classify the observatories in accordance with the changed conditions of their work. The following is the classification now adopted :—

1st.—*First class Observatories*, including Calcutta, Allahabad, and Lahore, at which continuous registration is effected by automatic methods, and Mussooree or Simla, at which special actinometric observations of a strictly scientific character are taken.

2nd.—*Second class Observatories*, at which a set of observations is taken daily at 8 A.M., and telegraphed to Simla, Calcutta or Bombay for the preparation of the daily, weekly and monthly reports, issued as early as possible for the information of the public, and two sets of observations daily at 10 A.M. and 4 P.M., utilized in the preparation of the Annual Report, or scientific review of the weather of the year.

3rd.—*Third class Observatories*, the great majority of which will take daily a set of observations at 8 A.M. only, to be telegraphed to Simla, Calcutta or Bombay, but a few of which (as for example, Kailang, Leh, Nancowry, Amini Divi, &c.) will not for many years, if ever, be able to communicate by telegram with Simla, and will hence take observations either at 10 A.M. and 4 P.M. as heretofore, or at 8 A.M. only, as may be found most desirable. These latter observations will be utilized either in the Annual Report or in the Daily Weather Charts of the whole Indian land and sea area which it is proposed to prepare and publish shortly.

7. In connection with the above re-classification, it was determined to pay observers or the amount of work they performed. The following rates of payment were sanctioned by the Government of India with effect from the 1st of January 1889:—

	Per mensem. R
(1) For taking 8 A.M. observations and despatching weather telegrams	10
(2) For recording 10 and 16 hours' observations as well as taking 8 hours' observations and sending daily weather telegrams	18
(3) For taking only 10 and 16 hours' observations	12
(4) Additional payment to observers at certain coast stations who send, as part of their regular duty, storm telegrams for use in connection with the storm warning work of the Department	5
(5) Additional payment to observers in charge of automatic wind registering instruments. (This allowance is only given, if a Beckley's Anemograph be kept in addition to an ordinary wind-vane and anemometer)	4
(6) Additional payment to observers who take special observations of solar and grass radiation thermometers	3

8. (II).—*The permanent adoption of the system of telegraphing rainfall information to Simla introduced tentatively in 1888, and the establishment of a uniform system of rainfall registration throughout India.*—The system introduced in the year 1888 was explained in last year's Administration Report. It enables the Department to prepare rainfall charts and statistics for the information of the Government of India of a more satisfactory and comprehensive character than hitherto, and to give a fairly complete and systematic view of the distribution of the south-west monsoon rainfall throughout the whole season from week to week. The reasons for the introduction of a uniform system of rainfall registration were fully explained in last year's Administration Report (pages 5—9). The Local Governments have expressed their willingness to assist in the adoption of such a system, and a common hour of observation, *viz.*, 8 A.M., has already been introduced. Rainfall is hence now measured at one and the same hour at all rain-gauge stations, as well as at the meteorological observatories, and the first and most important step has hence been taken towards the establishment of a uniform and satisfactory system of rainfall registration throughout India. The Local Governments will be consulted as to the other changes that are necessary or desirable to complete this step, and it is probable that the whole of the changes and improvements necessary will be introduced not later than the 1st January 1890.

9. (III).—*The permanent transfer of the working and control of the Bombay Coast Storm Signal Service to Simla and the establishment of a local system at Bombay in*

order to give early weather information to the commercial community of Bombay.—The refusal of Mr. Chambers to accept the Western India Reportership under the new conditions made it necessary to appoint a successor and to re-adjust the work of the Bombay Meteorological Office to the new conditions. The present Reporter is a half-time officer, and is liable to be called away from Bombay on duty for short periods. It therefore seemed to me to be best to continue to carry out the work of warning the west coast of India from Simla, whither it had been temporarily removed during the interval between the retirement of Mr. Chambers and appointment of Mr. Hutchinson. It appeared to be undesirable to entrust the duties of the Bombay storm-warning work (which had recently been considerably extended) to that officer, for whom there may not be an efficient substitute ready to take them up in case of enforced absence from illness or other causes. Hence I arranged for the future performance of this duty by the Simla Office, where there are two whole-time officers, each of whom has had long experience in the work of storm-warning.

10. The Bombay Port Trust and Bombay Chamber of Commerce some time ago called the attention of Government to the necessity of the publication by the Bombay Meteorological Office of a local Daily Weather Report and chart, similar in form to that published in Calcutta by the Bengal Meteorological Office. The Government of India requested me to arrange for the publication of a suitable Report and Chart at Bombay if I possibly could, under the changed conditions of the Western India Reportership, and hence I included it in my reorganization scheme submitted last September. I learnt, when in Bombay in July 1888, that both the Chamber of Commerce and Port Trust might contribute towards the cost of carrying out this desired extension of work. Hence, shortly after Mr. Hutchinson was appointed, I sent Mr. Dallas to Bombay, to assist Mr. Hutchinson in ascertaining what amount of local support could be obtained, and to prepare the details of a scheme which I could submit for the sanction of the Government of India. The Chamber of Commerce, while reserving its opinion as to the expediency of the changes effected in the Western India Reportership, promised to contribute liberally to the scheme for one year, as an experimental measure, in order to obtain for Bombay, as speedily as possible, the publication of a suitable Daily Weather Report and Chart. The Government of Bombay agreed to print it at the Secretariat Press. The Port Trust after considerable delay refused to give any assistance, pecuniary or otherwise, unless the Government of India retraced the steps they had taken in connection with the Western India Reportership during the previous six months. I was therefore obliged to submit a scheme based on the local support of the Bombay Government and the Chamber of Commerce only, and hence on a somewhat more limited scale than I had originally hoped and intended. The Government of India sanctioned the scheme. As the report, I felt, would be doubly valuable to the Bombay public if it were introduced before the commencement of the south-west monsoon, I made arrangements to start it about the middle of May of the present year. With the ever-ready assistance of Colonel Waterhouse, Superintendent of the Lithographic and Photographic Departments of the Survey of India Office, Calcutta, a suitable chart was prepared as speedily as possible. I may add, although the subject belongs properly to the administration of the present year, 1889-90, that I proceeded to Calcutta at the end of April to expedite matters, and thence went across to Bombay to assist Mr. Hutchinson in commencing the issue of the report. Mr. Dallas, when in Bombay

in December, had initiated Mr. Hutchinson into the methods employed at Simla and Calcutta for preparing the Daily Reports and Charts, and the draughtsman who was engaged for the work came up to Simla for three weeks in April 1889 and was instructed in his future duties. The Report under these preparations was issued without any difficulty and in a form which was very generally approved by the members of the Chamber of Commerce. The first Report issued to the Bombay public was that for Monday, the 19th of May. It will, it is hoped, become a permanent feature of the work of the Reporter for Western India, and receive the modifications and improvements which experience only can suggest to make it more useful for the information of the Bombay commercial public. The Department is very largely indebted to the Hon'ble Mr. Forbes Adam, Chairman of the Chamber of Commerce, for valuable advice and suggestions, which enabled Mr. Hutchinson to commence the issue of the report in a satisfactory form and manner.

11. (IV).—*The extension of the present system of collecting meteorological information from the Captains of vessels navigating the Arabian Sea and the Bay of Bengal.*—The necessity for the extension of the work of observation in this direction has been long recognised. It is absolutely essential for the investigation of the causes of the origin of cyclonic storms. Hitherto information has been mainly sought of the weather during cyclones, but not of the antecedent weather and conditions which led up to and originated these storms. Information of the weather in the Indian seas is even more necessary in dealing with the causes which affect the strength of the great rain-giving currents of the south-west monsoon. These currents advance from the sea into India, and their strength and variations of strength probably depend as much upon conditions in the sea area from which they advance as in the land area of India itself. It is hence necessary that observations of the weather in the sea area should be collected as regularly and systematically as for the land area. The work was commenced some years ago by the Calcutta Office for the Bay of Bengal, but greater attention to and interest in this portion of our work will almost certainly result in the collection of fuller and more satisfactory information. The method of collecting the information has been considerably improved since the beginning of the year, and with very satisfactory results. The work has also been commenced at Bombay and is now being carried on upon exactly the same methods as at Calcutta. The refusal of the Bombay Port Trust to contribute towards the cost of the additional clerical staff, &c., necessary for the preparation of the Bombay Daily Report and Chart, has compelled the Reporter to utilize frequently the services of the clerk whom I had intended to employ solely on the work of collecting meteorological data from vessels entering Bombay Harbour, in the preparation of the Bombay daily report. It is much to be regretted that the action of the Port Trust, which is specially interested in the collection of any information that would throw light upon the origin and tracks of storms in the Arabian Sea, should have delayed the commencement of this work for the Arabian Sea in a satisfactory manner. With the aid of the Port Officers at Calcutta and Bombay and other local assistance, I hope that this work of collecting systematically, all the year round, weather information respecting the Indian seas, will be rapidly placed on a proper footing. If sufficient daily information be forthcoming to give a fairly adequate view of the general weather conditions in the Indian seas, a daily chart, including the whole of these observations in the Bay of Bengal and Arabian Sea, and also at certain Indian and extra-Indian stations, including

Port Blair, Amini Divi, Aden, Perim, the Seychelles, Bushire, Baghdad, &c., and of those already published in the ordinary India Daily Weather Report, will be prepared and published for at least two or three years, and if found to give useful and valuable information, become a permanent feature of the work of the Department. Its value will evidently depend almost entirely upon the extent of the sea information obtained. The chart will include the whole Indian area (land and sea) bounded by the meridians of 53° E. and 105° E. and the parallels of 10° S. and 35° N. These Reports and Charts, if commenced, will usually be published some three or four months after date, in order to allow of the collection of the whole of the available data. It is evident that the publication of such charts, even for a limited period of two or three years only, would be of very great advantage. They would be specially useful in tracing the origin and antecedent conditions of cyclones, and the conditions at sea which precede and determine the first advances of the south-west monsoon current, and the subsequent variations in its intensity and accompanying rainfall, and in discussing many other similar questions. It may be pointed out that the collection of such data in connection with storm investigation is even more necessary for the Arabian Sea than the Bay of Bengal. The latter area is enclosed on all sides except a portion of the south, and is surrounded with a battery of observing stations to the west and north as well as on the east. The Arabian Sea has a line of observatories on the east side only which give information or indications for only a narrow belt of the sea near the Bombay or west coast of India.

12. (V).—*The introduction of arrangements for the collection of special observations during storms, and the recognition of these observations as part of the duties of observers by special payments for these observations.*—The work of observation with regard to storms has been hitherto very defective. It was recognized in the rules drawn up many years ago by Mr. Blanford for the guidance of observers that it was part of their duties to take frequent observations during storms, but they neither received any pay for this special work, nor was any deduction made from their pay, if they neglected the duty of taking these observations. It was hence voluntary unpaid work, and as its performance is attended with much physical discomfort, it was almost entirely neglected. As, however, storms form on the whole the most important feature of the weather, the registration of meteorological observations during their existence is as absolutely essential as of the regular observations. The continued neglect of this part of the work of observations rendered it necessary to make new arrangements for the proper registration of observations during storms. I therefore proposed to Government that the annual grant of Rs. 3,000 for special allowances of Rs. 5 and Rs. 10 per mensem to thirty observers should be employed in future for the collection of storm observations. The Government approved of the suggestion, and the special allowances have been discontinued, and the grant will, in future, be utilized in making payments for series of storm observations. These, it may be pointed out, are of two kinds. The first are those observations which are required at frequent intervals during stormy weather from observers at coast stations, in order to enable the storm-warning officer at Calcutta or Simla to judge of the character of an approaching storm as early as possible and to hoist the necessary storm signals without delay. They are hence absolutely necessary for the proper performance of an important part of the work of the Department, and are utilized immediately after they are recorded and despatched by telegram. To the second class belong all those storm observations which

are useful in discussing and investigating the causes, origin, and phenomena of the various classes of storms to which different parts of the country are subject, *e.g.*, thunder-storms, hail-storms, nor-westers, &c., &c., as well as cyclonic storms. Early information of the occurrence of violent storms is always desirable for statement in the Daily Reports. These observations are however mainly required in connection with storm investigation, and for this purpose accurate and minute observation during a few storms of each class would probably be far more useful than hasty and careless observation of a great many. It is also evident that these observations will usually not be utilized for the purpose for which they were collected, *viz.*, the investigation of storms, until some considerable time afterwards. In the case of the first class of storm observations, the observer must be prepared to take and send off, as quickly as possible, accurate observations of the kind required whenever the storm-warning officer calls for them. As he is always liable for the duty, an allowance of Rs 5 per mensem is made for this work in addition to his ordinary pay as observer. For the second class of storm observations, what is required is that the observer should either not take any storm observations at all, as careless and hasty observations are worse than useless, or that he should take in an intelligent manner as full and accurate a record of each severe storm that passes over the observing station by means of his meteorological instruments and observations of the sky, &c., as is possible. It has hence been decided, with the sanction of Government, to make small grants (varying usually from Rs 1 to Rs 10) for each series of storm observations taken by an observer, the total amount for each observer to be assigned at the end of each year after a careful examination of all the storm observations sent in during the year. Full instructions to observers for these observations were drawn up in January, and were sent to each observer, together with note-books for the record of any storm observations that might be taken. The results, so far, have been satisfactory, and several valuable series of observations during dust-storms and nor'westers were sent in during the hot-weather months of the present year.

13. (VI).—*The introduction of arrangements for the utilization of the services of duly qualified Scientists in Europe for the discussion of some of the more important series of observations which have accumulated in the Calcutta Office during the past thirteen years.*—I called the attention of the Government some time ago to the large increase of work in the Simla and Calcutta Meteorological Offices, due partly to the extension of storm-warning work, and to the much greater attention and labour now devoted to the preparation of the Daily Reports than was formerly the case, and pointed out that neither Mr. Dallas nor myself would have sufficient leisure to discuss the various series of observations that are being taken at the present time to serve as data for the scientific investigation of important questions of the meteorology of India and those which have been made during the previous thirteen years. I further pointed out that there were several important complete series of observations which had been taken during the previous thirteen years lying at the Calcutta Office awaiting discussion. Among these are the following:—

- (1) Hourly observations taken during a large number of years (varying from 10 to 13) at 26 second class stations. These observations have cost Government upwards of a lakh and a half of rupees. It would be advisable to have them thoroughly discussed, and the results published as early as possible, and thus obtain some practical value for this large expenditure.

- (2) Anemographic observations taken for several years at 14 stations in different parts of India by means of self-recording instruments.
- (3) The continuous series of observations taken at Alipore, Allahabad, and Jeypore during past years by self-registering instruments.

In order that these observations, accumulated at much cost and labour, should be utilized without unnecessary delay, I suggested the adoption of the plan indicated above which has already been tried by the Geological Survey Department and found to work very satisfactorily. There are several distinguished meteorologists in Europe who have ample leisure for the discussion and investigation of any of the series of observations in the previous list, and would probably be glad to undertake the work for a moderate remuneration. Such an arrangement would be the most economical for having these series of observations completed by a thorough and exhaustive discussion, and the grant assigned for the purpose would not only be devoted to the objects for which it was intended, but would only be utilized when there are series of observations awaiting discussion. The Government have sanctioned an annual grant under this head, and I am making arrangements for the commencement of the work, which I shall shortly submit to Government for formal approval.

14. (VII).—*The re-adjustment of work and establishments at the central and local Meteorological Offices, and the adoption of certain changes for increasing the efficiency of the Calcutta and Simla Offices.*—The reasons for the changes which have been adopted under this head may be briefly summarized as follows:—

- 1st.—The regular observations under the present system consist of two series, *viz.*, those taken at 8 A.M. for the current Daily Report work at Simla, Calcutta, and Bombay, and those taken at 10 and 16 hours. The tabulation and critical examination of the whole of the 8 hours' observations (with the object of eliminating erroneous observations) is carried out by the Simla and Calcutta Offices. The number of observatories recording 10 and 16 hours' observations has been diminished to 69. The reduction and tabulation of these observations under the old system were chiefly effected in the Provincial Meteorological Offices, and the final critical examination in the Calcutta Office. The reduction in the number of observatories furnishing these observations is so large as to materially reduce the amount of work in the local meteorological offices, and hence made it possible to effect some reduction in the establishments of these offices.
- 2nd.—There were two Meteorological Offices in Calcutta (*viz.*, the India Meteorological Office and the Bengal Meteorological Office) located in the same building, 5, Russell Street, both performing work of the same general nature, and each provided with a Head Clerk. This was a needlessly expensive arrangement, as either Head Clerk was capable of controlling both offices. Hence the amalgamation of these two offices into one under one Head Clerk formed a part of my proposals,—more especially as it enabled me to suggest the employment of the Bengal Head Clerk in the work of inspection. The reasons for this are given in the next paragraph.
- 3rd.—The work of inspection of Indian meteorological observatories is of two kinds. The first has for its object to ascertain any peculiarities in the sur-

roundings of an observatory which may affect the observations, the exact conditions of exposure of the instruments, the capacity and fitness of the observer for his work, and the general condition of the instruments. This is satisfactorily performed by the Imperial and Provincial Reporters. It however frequently happens that the observations submitted by an observer differ to such an extent from those at neighbouring stations as to show that either the observer is careless, the instruments are out of order, or the observations in question are due to some abnormal meteorological conditions which it would be very desirable to ascertain and investigate. It is however absolutely necessary before assuming that the last is the true cause to be sure that the observations are at the time not vitiated by carelessness on the part of the observer, or by defects of the instruments. It is hence necessary, if the discussion of abnormal meteorological conditions (as distinguished from erroneous observations) is to be seriously dealt with from a scientific standpoint, that an officer should be attached to the India Office who can be sent off at any time to visit an observatory in any part of India, and to remain there as long as may be necessary to ascertain exactly the real nature of any prolonged series of abnormal instrumental readings. He would also be exceedingly useful in establishing new observatories and in teaching observers at distant stations and carry out quickly, expeditiously and economically work which at the present time can only be performed by the Provincial Reporters in the uncertain intervals of College vacations, &c. The greater part of the work of inspection (such as, for example, seeing whether the shed is free from weeds and is properly thatched, the thermometers are clean and properly suspended, &c.) is such as can be as well performed by a properly trained Native assistant as by the Reporters themselves.

4th.—The extension of the Indian Daily Weather Report work and the addition of the Bombay storm-warning system to the duties of the Simla Office has, during recent years, curtailed the stay of the India Reporter in Calcutta during the cold weather. The control of the India Meteorological Office and of the Alipore Observatory and the superintendence of the Time Ball Service have hence been handed over for some years past to the Bengal Reporter during the greater part of the year. The increasing duties of that officer have latterly prevented him performing this additional work, which was no part of his recognized official duties, fully and satisfactorily and it had hence become necessary to provide an officer to perform this part of the work of the India Meteorological Department. Such an officer was also necessary at Calcutta for two additional reasons. He would be able to superintend continuously and effectively the collection of meteorological information from shipping entering the Port of Calcutta. Lastly, he would be qualified to take up the duties of the Bengal Reporter and prepare the daily reports, issue storm-warnings, &c., in case of the illness of that officer. This is especially necessary now that the storm-warning duties of the Bengal Reporter have been so largely extended as to include the whole coast of the Bay of Bengal from Tavoy in Burma to Tuticorin in Southern India, and necessitate constant watchfulness for at least nine months of the year.

15. The changes which I proposed in my reorganization scheme submitted on 1st September 1888, based on these considerations, and which were sanctioned and brought into effect from the 1st of January 1889, were as follows:—

- (1) The abolition of the Punjab Meteorological Office at Lahore, and the elevation of the Lahore Observatory from second to first class. A complete set of autographic instruments which had been ordered upwards of four years previously by Mr. Blanford to equip the Lahore Observatory arrived in May 1888, so that the elevation of the Lahore Observatory to first class was an urgent matter. The abolition of the Punjab Meteorological Office at Lahore enabled me to retain the services of the clerks in the Punjab Meteorological Office as observers in the Lahore Observatory; and to raise it to the status of a first class observatory at no increase of cost to the State.
- (2) The reduction of the establishment of the Allahabad Office by one clerk, that of Bombay by two clerks (specially engaged from January 1886 to assist Mr. Chambers in carrying out meteorological investigations), that of Madras by two clerks, and that at Calcutta by one computer and three clerks. The Simla Office was increased to a slight extent in order to enable the daily report work, and the weekly rainfall and other reports to be prepared more rapidly than hitherto, and to provide the Reporter and Assistant Reporter with a small office establishment to assist them in carrying out special investigations, &c.
- (3) The two Meteorological Offices at Calcutta were combined into one Central Office and placed under the charge of one Head Clerk, *viz.*, Babu Fanindra Mohan Basu, previously Head Clerk of the India Office.
- (4) The appointment of Mr. C. Little as 2nd Assistant Meteorological Reporter to the Government of India, to superintend a portion of the work of the Central Office (more especially the collection of meteorological data from vessels entering the port of Calcutta), the working of the Alipore Observatory, and the dropping of the two Time Balls in the port of Calcutta. He has also been instructed to qualify to take up the storm-warning duties at Calcutta, so that, in the event of any sudden illness or any other cause which may temporarily prevent the Bengal Reporter carrying out the daily report and storm-warning work, there may be a second officer on the spot qualified and ready to take up these important duties.
- (5) The appointment of Babu Chandi Charan Chatterjee, previously Head Clerk, Bengal Meteorological Office, to be Inspector of observatories. Part of his previous duties as Head Clerk was to inspect observatories. He went through a course of training at the Mathematical Instrument Department in the repair and adjustment of instruments, and is hence specially qualified for the work.

SEASONAL FORECASTS.

16. The forecast of the probable character of the south-west monsoon was made in a slightly different manner last year than in previous years. The Government of India called for a forecast in the second week of May, or nearly three weeks earlier than usual. In accordance with this request a preliminary memorandum or forecast was issued by the Department on the 18th of May, and the ordinary or final memorandum,

based on information received up to the end of May, was issued on the 9th of June. These forecasts are based partly on information of the snowfall in the mountain districts of Northern India during the previous cold weather months, and partly on the distribution of pressure in the month of May and the changes in the abnormal features of the pressure distribution that have been effected during the hot weather months of April and May and the character of the hot weather during these months.

17. The following gives a brief summary of the data on which the forecast of the character of the rainfall during the south-west monsoon of 1888 was based :—

(A). *Snowfall information.*—The amount of the snowfall over the greater part of the Afghan mountain tract and the north-west Himalayan area during the preceding cold weather, December 1887 to March 1888, was much below the normal. As this was also the case in the winter of 1886-87, it is very probable that the extent and depth of snow on the Himalayas were less than at the same period during the past five or six years. This inference is confirmed by the fact that the depth of water in many of the glacier and snow-fed rivers was unusually low in April, May, and June 1888. The snowfall in the Eastern Himalayas was either normal or below the average.

(B). *Meteorological conditions of the antecedent hot weather.*—The weather in Northern India during the three months, March to May 1888, was such as usually accompanies very deficient snowfall in the Himalayas. Temperature increased more rapidly than usual, and higher temperatures were registered in the Punjab than for some years past. One important effect of rapidly increasing temperature in Northern India is to give rise to brief periods of general disturbance. The chief features are strong sea winds in the Bengal coast districts, thunderstorms in Bengal and near the hills in Northern India, and duststorms in the plains of the Punjab, Sind, Rajputana, and Central India. These periods rarely last for more than three or four days and are again succeeded by fine clear weather with another burst of rapidly increasing temperature in the interior. These features were present in an exaggerated form during the hot weather of 1888. The southerly winds in Bengal were very strong in April and May, and considerably above their normal force, approaching to a gale on several occasions. Hot-weather thunderstorms and hailstorms were more violent than for many years past, and in several cases developed into tornadoes, comparable in destruction to life and property, with the whirlwinds that occur during the summer in the southern districts of the Mississippi Valley in the United States.

The pressure anomalies or variations from the normal were also such as accompany diminished snowfall in the mountain districts of Northern India. The pressure anomalies of May were identical in character and almost identical in amount with those of the month of April, and were remarkably persistent and due to large and permanent causes or actions.

The following were the chief anomalies of the month of May :—

1st.—Pressure was slightly below the average over India.

2nd.—Pressure was, relatively to the general state, locally in defect in Burma, Assam, Bengal, the North-Western Provinces, the Punjab, and the greater part of Rajputana and Sind. The deficiency was slight on the Burmese, Bengal, and Sind coasts, and increased from the Bengal coast to East Assam in one direction and to the Punjab in the other.

3rd.—Pressure was relatively in excess over the greater part of the Peninsula. This excess was greatest in the West Deccan and Central Provinces, in which it averaged '048" and '040" respectively. The excess in May was less in the Bombay coast districts than it was in April, and was slightly greater in the Deccan.

The variations were in many respects similar to those of May 1887. The chief differences were that the area of excessive pressure in the Deccan extended in May 1888 into the Central Provinces, and was somewhat more strongly marked, and that there was a largish deficiency of pressure in Assam and probably North Bengal, whereas in May 1887, there was a slight excess in that area.

18. The following were the conclusions or forecast based on these facts :—

1st.—The low pressure which obtained over Northern India from East Bengal to the Punjab, and increased in amount westwards favoured the early establishment of the Bengal current over Bengal and the Gangetic Valley to which it would probably give normal or abundant rain.

2nd.—The distribution of pressure in Southern India (more especially in the West Deccan and Central Provinces) was such as is usually associated with delay in the establishment of the monsoon on the Bombay coast and with diminished rainfall in the Bombay-Deccan.

3rd.—The unfavourable conditions in Southern India accompanied favourable conditions in North-West India, as was the case in 1887. It was hence not probable that the monsoon rainfall in the Deccan and Central Provinces would be largely reduced below its normal amount.

It was further added that the presence of the high pressure area in the Central Provinces would probably cause the cyclonic storms of the rains to advance along a westerly track further to the north than usual.

19. The following table, extracted from the Weekly Rainfall Report of the last week of September 1888, affords a basis of comparison between the forecast and the actual rainfall results of the south-west monsoon of 1888 :—

PROVINCE.	DIVISION.	RAINFALL DATA FROM MAY 14TH TO OCTOBER 1ST, 1888.		
		Average actual rainfall of season.	Average normal rainfall, May 14th to October 1st.	Excess or defect of (seasonal) rainfall expressed as a percentage.
		Inches.	Inches.	Per cent.
BURMA	Tenasserim	?	149'96	?
	Lower Burma	71'10	86'12	—17
	Central do.	89'05	68'63	+30
	Upper do.	30'05	?	?
	Arrakan	164'55	168'41	— 2
BENGAL AND ASSAM	Eastern Bengal	62'64	76'39	—18
	Assam (Surma)	114'64	81'59	+41
	Do. (Brahmaputra)	55'90	66'75	—16

PROVINCE.	DIVISION.	RAINFALL DATA FROM MAY 14TH TO OCTOBER 1ST, 1888.		
		Average actual rainfall of season.	Average normal rainfall, May 14th to October 1st.	Excess or defect of (seasonal) rainfall expressed as a percentage.
		Inches.	Inches.	Per cent.
BENGAL AND ASSAM . . .	Deltaic Bengal	50'49	48'00	+ 5
	Central do.	43'71	47'82	— 9
	North do.	70'77	89'17	—21
	Orissa	42'87	45'44	— 6
	Chutia Nagpur	47'22	45'03	+ 5
	Behar (South)	42'36	37'36	+13
NORTH-WESTERN PROVINCES AND OUDH.	Do. (North)	41'52	43'74	— 5
	North-Western Provinces (East)	40'61	33'96	+19
	Oudh (South)	45'34	33'86	+34
	Do. (North)	42'40	35'81	+18
	North-Western Provinces (Central)	47'45	27'99	+70
	Do. do. (West)	31'87	27'35	+17
PUNJAB	Do. do. (Sub-montane)	46'08	35'82	+33
	Punjab (South).	7'83	12'29	—37
	Do. (Central)	19'19	21'12	— 9
	Do. (Sub-montane)	26'59	24'20	+10
	Do. (Hill Districts)	50'83	42'43	+11
	Do. (North-West)	11'24	17'41	—35
BOMBAY AND MALABAR COAST DISTRICTS (Madras).	Do. (West)	4'49	6'52	—31
	Malabar	114'96	101'71	+13
	Madras (South Central)	22'34	14'93	+50
	Coorg	94'24	114'87	—18
	Mysore	14'08	21'29	—34
	Konkan	104'55	92'09	+14
CENTRAL PROVINCES AND BERARS.	Bombay-Deccan	26'42	27'55	— 4
	Khandesh	15'67	22'49	—30
	Berars	27'51	31'70	—13
	Central Provinces (West)	31'50	38'18	—17
	Do. (Central)	42'71	4'93	—11
	Do. (East)	38'60	43'61	—11
BOMBAY (North)	Guzerat	20'75	38'84	—47
	Kathiawar	6'75	18'21	—63
	Sind	0'16	3'85	—96

PROVINCE.	DIVISION.	RAINFALL DATA FROM MAY 14TH TO OCTOBER 1ST, 1888.		
		Average actual rainfall of season.	Average normal rainfall, May 14th to October 1st.	Excess or defect of (seasonal) rainfall expressed as a percentage.
		Inches.	Inches-	Per cent.
RAJPUTANA AND CENTRAL INDIA.	Central India (East)	34'39	29'60	+16
	Rajputana (East)	} 20'42	23'68	-14
	Central India (West)			
	Rajputana (West)	14'49	12'89	+12
MADRAS	East Coast (North)	17'96	24'54	-27
	Hyderabad (South)	12'09	22'03	-45
	Madras (Central)	13'78	17'00	-19
	East Coast (Central)	13'79	17'39	-21
	Do. (South)	13'86	14'51	-4
	Madras (South)	5'11	7'93	-36

A comparison of the percentage results of the preceding table with the statements of the forecast will show that they were in very fair agreement with these results. The great majority of the storms of the rains, it may also be noted, advanced by a more northerly track than usual into East Rajputana and the North-Western Provinces.

WEATHER REPORTS AND CHARTS (DAILY, WEEKLY, &C.)—

20. The Weather Reports published by the India Meteorological Office for the information of the Government and the public are the following:—

(a) India Daily Weather Report and Chart.

(b) India Weekly Weather Report, published in the *Gazette of India*.

(c) India Monthly Weather Report, also published in the *Gazette of India*.

21. The India Daily Weather Report and Chart was issued during the greater part of the year in the same form as during the last three months of the year 1887-88. Important improvements were made in it on and from the 1st January 1889. During the previous nine months the Calcutta Office had gone carefully through the records of previous years and obtained daily averages of pressure and of maximum and minimum temperature for all stations. The daily means are for 8 A.M., and were derived from the means of the 10 A.M. observations by suitable corrections deduced from the hourly observations recorded at a considerable number of stations in all parts of India. These means hence enable a far more exact comparison between the meteorological conditions of pressure and temperature for each day and the normal conditions to be made than has hitherto been possible. Additional columns have been given in the Daily Weather Report from the 1st of January, showing the variations of the 8 A.M. pressure and of the maximum, minimum and mean temperatures of the previous 24 hours from the normal values of these elements for the same day. The daily averages of rainfall used in the Daily Report up to the end of 1888 were calculated in the years 1878, 1879 or 1880 on the data of previous years, and no changes had been made based on later rainfall returns. It was found last year that these averages differed in some cases very considerably from the

averages published in the Annual Reports based on the rainfall returns up to the date of these reports. The whole of the rainfall averages now used in the Daily Report were re-calculated and are based on the information in the office up to the end of the year 1888.

The Daily Report in its present form hence appears to give a fairly complete view of the current weather and of its variation from the normal, and is, I believe, in both these respects one of the most complete issued by any Meteorological Department. The only further extension I have in view, but which will probably require some time to carry out, is the addition of two small charts at the foot of the present large chart, showing, by means of lines, &c., the variations of the 8 A.M. pressure and of the mean temperature of the previous 24 hours from the normal at a glance.

The following is a summary of the distribution list of the India Daily Weather Report as it stood on the 1st of April 1889:—

	Number of copies.
Government Officers	239
Subscribers in India	2
Meteorological Societies and Departments in Europe and America .	25
Distinguished meteorologists in Europe and America	2
Filed in office for use or future supply	13
TOTAL	281

22. The Weekly Report was considerably enlarged during the year in order to give a summary of the rainfall information for the previous week telegraphed by District offices in accordance with the new arrangements (*vide* pages 8—9 of last year's Administration Report). It was at first intended to adopt Mr. Blanford's subdivisions of India, employed in his monograph on the rainfall of India. As it was however ascertained that the Financial Department were considering a division of India into areas which would form a suitable basis for the discussion of crop reports, prices of staples, &c., it seemed to be very desirable that the same division of the country should be adopted by the Meteorological Department, in order to enable an exact and easy comparison to be made between crops, prices, &c., and the amount and distribution of rainfall and its variation from the normal. In consultation with Mr. O'Connor of the Financial Department this was effected, and the divisions for which the rainfall data are given week by week in the Weekly Report are identical with those adopted by the Financial Department. Each area is, so far as is possible, fairly homogeneous with respect to its crops and meteorological conditions (more especially rainfall).

23. The Monthly Weather Report has been enlarged and improved to some extent, and gives a more complete view of the weather during the month than was formerly the case. It is however not altogether satisfactory, and as soon as I can determine what would be its best form for permanent adoption, I shall lay before Government the improvements and changes I consider desirable for consideration and sanction.

24. The Simla Office prepared weekly charts (drawn by hand) showing the progress of the south-west monsoon rains of 1888 up to date during the period 15th May to 15th October, and the Calcutta office four series of average rainfall seasonal charts of the whole of India, as in previous years, for the information of the Secretary of State and the Government of India.

25. The Calcutta Meteorological Office published the following reports during the year :—

1st.—Daily Weather Report and Chart of the Bay of Bengal. This is prepared in connection with the Bengal Storm Signal Service, and is chiefly circulated amongst commercial and mercantile men in Calcutta. No change, beyond the addition of observations from Tavoy, Pooree, Nellore and Cuddalore, was made in its form during the year. It was supplied to 23 paying subscribers (subscription Rs 2 per mensem) and to 33 non-paying recipients, chiefly Government officers. It was published daily throughout the whole year.

2nd.—The Bengal Daily Weather Report. This was established chiefly for the information of the Government of Bengal and its District officers to show the progress of the south-west monsoon rains, and to give current meteorological information to the Government during the period of the year when it is of the greatest value. It was published in 1888 during the period April 28th to November 9th, and gave information based on telegrams received from 41 observatories (including 20 Provincial). It was distributed to 102 non-paying and to 13 paying subscribers (chiefly mercantile firms in Calcutta interested in accurate rainfall data).

3rd.—The Bengal Weekly Meteorological Report, published in the *Calcutta Gazette*, giving the weekly means of observations at the several meteorological observatories in Bengal and Assam, and complete rainfall data of Bengal for the previous week, and a summary of the chief features of the weather during the week.

4th.—The Bengal Monthly Meteorological Report, also published in the *Calcutta Gazette*, gives the monthly means of the meteorological data furnished by 47 observatories in Bengal and Assam, complete rainfall data of the province (including the returns of 250 rain-gauge stations), and a full, discussion of the weather and meteorology of the month.

The Bengal Meteorological Office also prepared monthly three sets of rainfall charts showing the actual rainfall of the month, the variation from the normal rainfall of the month and the variation expressed as a percentage, for the information of the Bengal Government and Sanitary Commissioner. The Bengal Reporter also drew up a summary of the weather of the year 1887, and of the more important features of the south-west monsoon of 1888, together with a final and complete statement of the distribution of the rainfall in the province during the monsoon period, for the information of the Government of Bengal. The latter was published in the *Calcutta Gazette* in December 1888.

26. In the North-Western Provinces and Bombay monthly abstracts of the registers of the several observatories, and in the former, weekly rainfall reports were published in the local *Government Gazettes* during the year, and in the Punjab a descriptive summary of the weather of the province was prepared monthly in the Simla Office for the information of the Punjab Government and published in like manner. The Madras Reporter published a monthly statement of rainfall in the *Fort St. George Government Gazette*. The Simla Office drew up a preliminary report giving a summary of the weather in 1887 which was published in the *Gazette of India*. The Reporters for Western India and

the North-Western Provinces drew up brief sketches of the meteorology of their respective provinces in 1887-88.

ANNUAL REPORTS AND OCCASIONAL PUBLICATIONS.

27. The Administration Reports of the various Provincial Reporters for the year 1888-89 (which were utilized in the preparation of the present report) were received on the following dates :—

Bombay	3rd June 1889.
Bengal	10th „ „
North-Western Provinces and Oudh	14th „ „
Madras	29th July „

Those for the year 1887-88 were received on the following dates :—

Bombay	4th June 1888.
North-Western Provinces	5th „ „
Bengal	18th „ „
Punjab	27th „ „
Madras	11th July „

The Administration Report for the year, 1887-88, was prepared shortly after the receipt of the Provincial Administration Reports, printed in Calcutta, and submitted to Government on the 26th September 1888.

The Annual Report on the Meteorology of the previous year, 1887, was finished and placed in the printer's hands in August 1888, and was submitted to Government on the 30th January 1889.

The Report gave tables of temperature for 141 stations, and rainfall returns for 507 stations, being an increase of four in the case of the former and of seven in that of the latter, on the numbers respectively given in the Report for 1886. The returns of the other meteorological elements are nearly as numerous as those of temperature. The elements tabulated in the Appendix of the Annual Report are given in the following table. For comparison, the corresponding numbers for the four previous years are given :—

	NUMBER OF STATIONS.				
	1883.	1884.	1885.	1886.	1887.
Equilibrium temperatures of solar radiation	111	113	104	109	113
Duration of bright sunshine	2	3	4	6	6
Temperatures of nocturnal radiation	107	106	108	108	109
Temperatures of the ground	4	4	5	5	5
Mean and extreme air temperatures	134	138	133	137	141
Sea-level equivalents of mean temperatures	111	112	111	113	113
Means and extremes of atmospheric pressure	125	127	128	132	132
Sea-level equivalents of mean atmospheric pressure	109	110	110	111	107
Direction and movement of winds	127	128	128	132	135
Temperature of evaporation	124	128	131	127	131

	NUMBER OF STATIONS.				
	1883.	1884.	1885.	1886.	1887.
Tension of atmospheric vapour	130	135	130	134	138
Mean relative humidity	130	135	130	134	138
Mean proportion of clouded sky	127	130	131	135	137
Inches of rainfall in each month	462	478	486	500	507
Number of days on which rainfall was measured	462	474	482	500	507

The descriptive letter-press discusses the chief characteristics of the meteorology of the year and includes tables of the average values of all the more important meteorological elements for all stations that have furnished returns for three years and upwards. The Report is illustrated with five plates, *viz.*, a chart showing the position of all observatories and rain-gauge stations, three in coloured lithography representing the mean distribution of temperature, pressure and winds in each month of the year, and one showing the tracks of the storms which originated in the Bay of Bengal during the year.

The original observations of seven observatories, *viz.*, Calcutta, Lucknow, Allahabad, Lahore, Nagpur, Bombay and Madras, were issued as a distinct publication in monthly parts. Those forming the volume for 1887 were completed in April 1888.

28. The following parts of the Indian Meteorological Memoirs were issued during the year :—

Parts III and IV of Volume III, completing Mr. Blanford's very valuable monograph on the rainfall of India, were issued in May and August 1888 respectively.

Part V of Volume IV, containing an account of the cyclone of May and June 1881 in the Arabian Sea, drawn up by Mr. Chambers, Meteorological Reporter for Western India, was issued in November 1888.

The Hand-book of Cyclonic storms in the Bay of Bengal for the use of sailors is nearly ready for issue. Its preparation was considerably retarded by the extra work which was thrown upon me by the changes in the Bombay or Western India Reportership and by Mr. Dallas's absence on privilege leave.

The following have either been sent to press or will be sent to press in the following order :—

1st.—Account of the cyclonic storm of August 1888, prepared by Mr. Pedler.

This will form Part II of the *Cyclone Memoirs*.

2nd.—Account of the cyclonic storm of September 13th to 20th, 1888, and of the cyclone in the Bay of Bengal and the *Vaitarna* storm in the Arabian Sea in October and November 1888, drawn up by myself. This will form Part III of the *Cyclone Memoirs*, and will, with Part II, give an account of the most important cyclonic storms or cyclones of the year 1888 in the Indian seas.

3rd.—A short paper by Mr. Dallas on the relation between sunspots and weather as shown by meteorological observations taken on board ships in the Bay of Bengal during the year 1855-78.

4th.—An account of the storm of the first week of June 1887 in the Arabian Sea, compiled by F. Chambers, Esq., for publication in the *Indian Meteorological Memoirs*.

It is hoped that all these will be published during the present year.

The analysis of the cold weather storms in Northern India during the period 1876-88, referred to in last year's Administration Report as having been commenced, is not yet complete, but will probably be ready for publication next year. Mr. Dallas has undertaken, at my request, the preparation of storm track charts for the Arabian Sea for the various months of the year based on all available information. He will probably add a discussion on the distribution of cyclones in that sea area and on any peculiar features of these storms which his investigations may bring to light.

MARINE WORK.

29. As already explained in paragraph 11, I proposed in my reorganization scheme large and important extensions of work in this direction. As the proposals were not finally sanctioned until the month of February, and it was necessary to prepare and print forms for use in connection with the work, the extensions were not consequently brought into operation until after the end of the year 1888-89, and the work done during that year was hence entirely on the old lines. The following table gives a summary of the number of logs which have been collected and contributed in each year during the past five years :—

	1883-84.	1884-85.	1885-86.	1886-87.	1887-88.	1888-89.
Number of logs relating to the Bay of Bengal, collected by the Calcutta Office	254	164	161	211	210	332
Number of logs relating to the Arabian Sea	?	?	?	?	98*	78†

* Collected by both Calcutta (4) and Bombay (94) Offices.
† Do. (6) do. (7) do.

It will be seen that a larger number of logs was collected in the year under report by the Calcutta Office than in any previous year. A considerable part of the information thus obtained was of great use in the preparation of the accounts of the cyclonic storms of the year.

30. It was stated in last year's Report that I was endeavouring to secure a series of cloud observations in the south of the Bay and the Arabian Sea, in order to throw further light on the relations between the south-east trades and the south-west monsoon. In response to the circular issued there have been received up to date 16 series of observations, many of them most carefully taken and evidently the result of very accurate observation. Copies of all have been sent to the Hon'ble Ralph Abercromby, one of the greatest authorities at present on clouds and their relations to the prevailing air-currents, but the results of his examination of the observations have not yet been published.

ACTINOMETRIC OBSERVATIONS.

31. The actinometric work was continued at Mussooree during the greater part of the year under the general superintendence of Colonel Haig, R.E., Deputy Surveyor General, in charge Trigonometrical Branch Survey of India. These observations are chiefly taken in order to supply observations of a special nature for measuring the intensity of solar radiation to the Solar Physics Committee in England. They are forwarded in full to the

Committee at regular intervals. The maintenance of this Observatory at Mussooree involved the employment of an experienced European observer and an assistant observer, whose duties were almost entirely confined to observations of the heating power of the sun or the intensity of solar radiation so far as it affected the temperature of a column of mercury during fine clear weather. These observers had hence little or no actinometric work to do during the persistent cloudy weather of May, June, July, August and September. Their time was partly occupied by the record of observations at 10 and 16 hours, and in taking hourly observations on four days of each month. In May 1888 I deputed Mr. Hill to inspect the Observatory and obtain the opinion of Colonel Haig, R.E., as to the desirability of continuing these observations at Mussooree. Both these officers expressed doubts as to the value of actinometric observations taken at Mussooree, partly from the very large amount of cloud during the cold weather and rainy months of the year, and partly from the large amount of dust in the air during the hot weather months raised up by the strong hot day winds which blow in the plains at that time of the year. I then referred the matter to Mr. Blanford for opinion, and he ascertained that the observations which had been already taken were furnishing results of considerable interest and value, and hence that it would be unwise to discontinue them. It was finally decided to remove the Actinometric Observatory to Simla, in order that the actinometric work might be carried out under the immediate superintendence of the India Reporter. The amount of cloud and dust is, on the whole, less than at Mussooree, so that probably a larger amount of actinometric work can be done than at that station. When the weather is too cloudy for these observations the observers will be employed in the Simla Office to assist in the work of the reduction of observations, &c. The first observer had, for some time previous, been anxious to be admitted into the subordinate staff of the Survey Department. He passed the examination successfully and was appointed Assistant Surveyor from the 1st of January. Observations were then carried on by the 2nd or Assistant Observer (who was promoted to be 1st Actinometric Observer) at Mussooree until the 1st of March, after which the Observatory was transferred to Simla. The following gives the amount of work done during the year:—

Month.	Complete. Sets of observations.	Incomplete. Sets of observations.
April 1888	3	7
May „	0	0
June „	0	0
July „	0	0
August „	0	0
September „	0	1
October „	11	9
November „	2	10
December „	14	4
January 1889	4	6
February „	2	4
March (observatory transferred to Simla from 1st March 1889),		

STORM-WARNING SIGNALS.

32. The system in force for warning the ports of the Indian coasts of the approach of cyclonic storms at the end of the year 1887-88 was very fully discussed in last year's Administration Report, pages 14 to 17.

Those arrangements were as follows:—

The following ports on the Burmah, Bengal and Madras coasts were warned by the Bengal Reporter:—

(a) *Bengal ports*—

Calcutta and River Hooghly.
Chittagong.
Orissa ports, including Pooree, False Point, Chandbally and Balasore.

(b) *Burmah ports*—

Moulmein.
Rangoon.
Bassein.
Akyab.

(c) *Madras ports*—

Bimlipatam.
Gopalpur.
Vizagapatam.
Cocanada.
Masulipatam.
Madras.
Negapatam.
Tuticorin.

The following ports on the west coast of India were warned by the Bombay Reporter:—

(a) *Bombay ports*—

Karachi.
Bhavnagar.
Daman.
Bombay.
Ratnagiri.
Goa.
Karwar.
Vingorla.
Kumta.

(b) *Madras ports*—

Cochin.
Mangalore.
Calicut.

33. No large changes were made in the system of warning the Burmah, Bengal and Madras ports during the year. The following extracts from the Administration Report of the Bengal Reporter describe the smaller changes that were made to improve the working of the system:—

"In the present year there has been no further important change in the system of working of the Storm Signal Service of the Bay of Bengal, except that the observatories at Nellore and Cuddalore have been started from 13th September 1888 and 1st March 1889, respectively. These observatories were under construction last year. The Madras Government Astronomer who had previously supplied this Department with the meteorological information from that station having raised difficulties in the matter of sending additional observations when called for, in order to watch the progress of storms which were known to exist in the Bay of Bengal, and the course of which it was necessary to trace, the matter was reported to the Meteorological Reporter to the Government of India. A departmental Observatory was in consequence opened at Madras under the Port Officer, with the sanction of the Government of India, with effect from 7th January 1889. The observations recorded in the Bay of Bengal Daily Weather Report are now those taken at this departmental Observatory, and the Government Astronomer in charge of the Madras Observatory no longer supplies the daily meteorological telegrams to this office.

"It should here be mentioned that the Diamond Island Telegraph Service has improved very materially since the widening of the belt of cleared forest through which the line passes, the sanction for which was reported in the last Administration Report.

"In the present year there has been almost no break in the regularity of the telegrams from that station, and thus one of the standing difficulties in the way of the successful working of the Signal Service in previous years has been removed."

Mr. Pedler points out one defect in the present system which it would be desirable to improve. His remarks are as follows:—

"There is however another difficulty in connection with the Telegraph Service which demands attention, and that is in the communication with False Point. At present there is only telephonic communication between False Point Light-house, at which the Meteorological Observatory is situated, and Hookeytolah on the mainland, and it frequently happens that on the occasion of bad weather or of a cyclone approaching the Orissa coast, the communication is suspended several hours before the storm approaches the land. This at once makes it difficult to determine the line of march and the position of a storm with any degree of certainty. Even during such months as April and May, when strong southerly winds blow in the north-west angle of the Bay, it is found sometimes to be impossible to send in the daily meteorological telegrams with certainty and regularity, and thus in the first thirteen days in May 1889, on not a single day did the False Point telegram reach this office in time to be incorporated in the Daily Weather Report, and hence, for all practical purposes of rapid or early forecasting, these observations were useless.

"The Orissa coast has been found from experience to be the focus where a large proportion of the storms of the south-west monsoon period forming in the Bay strike, and it would hence be extremely desirable in the interests of the Storm Signal Service that the telegraphic communication over that area should be as perfect as possible. If, therefore, False Point could be made a regular telegraph station instead of being connected by telephone only, and if a cable could be run connecting it with Hookeytolah, a distance of probably only about 5 or 6 miles, much greater certainty in the receipt of meteorological information from almost the most important observing station on the west coast of the Bay would be ensured, and much greater facility would be obtained in the matter of issuing timely warning to the Orissa ports and to the shipping that lies at anchor in or near the False Point Harbour. The cost of this extension to the Telegraph Department could not be very large, and it would partly be recouped by the income from the Meteorological Department, which alone will almost pay the salary of a signaller who would have to be posted at the Light-house."

The improvement of the telegraphic communication with the False Point Observatory is very desirable in the interests of the Bengal Storm Signal Service, and the matter is now under consideration. If it be found that the Telegraph Department is not able to make the improvement suggested by Mr. Pedler, it would probably be desirable to remove the Observatory to Hookeytolah, and place it under the superintendence of the Port Officer.

34. The Telegraphic Code, as used for the communication of the weather observations by telegrams, while satisfactory for the ordinary observations, was found not to be well adapted for the preparation of telegrams of storm observations. A special Code (a modification of the ordinary Code), different in several respects from the ordinary Code, was hence prepared by Mr. Pedler and myself, and brought into use before the commencement of the present cyclone season. Some time ago, a suggestion was made to establish telegraphic communication with the Eastern Channel light ship at the entrance to the river Hooghly, partly for the purposes of obtaining earlier telegraphic information about cyclones advancing to the mouth of the Hooghly and the port of Calcutta, and partly for the use of shippers and merchants. Such an extension would be of great value in our storm-warning work. With the present line of observing stations round the coast there is usually no difficulty in recognizing the existence of a cyclonic storm from its earliest stages and its general direction of advance, and consequently the part of the coast which it will probably cross and to which it will probably give strong winds and gales. There is however one feature which it is very difficult to forecast with even approximate accuracy, and that is the intensity of an approaching storm. The indications of an intense cyclone are in its outskirts almost identical with those of a small cyclonic storm. The probable

intensity of an approaching cyclonic storm is the one point in forecasting in which experience and judgment are of the greatest value, and in which every increase of information in the proper direction is especially desirable and valuable to the storm-warning officer. Mr. Pedler hence arranged with the authorities that Pilots bringing vessels up the river should communicate by means of flags the last set of meteorological observations taken on board the pilot vessels (where they are recorded at four-hourly intervals) when passing Saugor Island Light-house, where they are observed and from whence the observations are telegraphed to the Meteorological Office. In order to carry out this method of receiving observations from the Sandheads, 60 to 80 miles south of Saugor Island, Mr. Pedler, with the assistance of Mr. Elson, Master Pilot, an authority on the subject, drew up a code by means of which it is possible to telegraph the barometer, wind direction and force, the weather, and the hour of observation, by a single hoist of five flags. By the use of this code the Bengal Meteorological Reporter now receives telegrams of the weather observations taken at the Sandheads five or six hours after the time of observation.

35. The following gives a brief summary of the various cyclonic storms in the Bay of Bengal during the year 1888-9, and of the action taken by Mr. Pedler in warning the coasts affected by them :—

Tables giving a brief statement of the storms which affected the Bay of Bengal coasts during the year 1888-89.

No.	Date.	Character.	Coast affected.
1	May 11th and 12th	Small storm off Madras coast	Crossed the South Coromandel coast on the evening of the 11th.
2	June 2nd to 5th	Small depression	Advanced in a north-westerly direction, and on the morning of the 5th passed over Orissa as a diffused depression.
3	June 10th	Small depression over the head of the Bay.	Passed across the North Orissa coast.
4	July 1st to 4th	Feeble depression in Central Bengal; gave a gale at the head of the Bay.	Gave heavy gales on the Bengal and Orissa coasts.
5	July 12th to 14th	Cyclonic storm formed in the north of the Bay and gave very bad weather and strong winds in the north of the Bay.	Crossed the Ganjam coast on the evening of the 14th.
6	July 19th and 20th	Feeble depression close to the coast of the Sunderbuns.	Moved inland past Saugor Island on the afternoon of the 19th.
7	August 4th	Feeble depression over the head of the Bay.	Advanced inland across the North Orissa coast.
8	August 19th to 24th	Severe storm near the Sandheads; gave winds of hurricane force near the head of the Bay.	Continued to intensify slowly until the 24th and then passed inland near Saugor Island.
9	September 5th to 7th	Small storm in the north-east of the Bay.	Passed across the head of the Bay and struck the Balasore coast on the 7th.
10	September 13th to 16th	Fierce cyclonic storm formed in the Gulf of Siam; gave stormy weather in the Andaman Sea, and severe cyclonic weather in the north of the Bay.	Crossed Tenasserim and the Martaban Gulf and then advanced across South Pegu and the centre of the Bay and struck the Orissa coast early on the morning of the 16th.
11	October 1st to 7th	Cyclonic storm of moderate intensity generated to the south-west of Diamond Island. It gave heavy weather at the head of the Bay.	Advanced first in a north-westerly direction towards the Orissa coast and then recurved in a north-easterly direction and crossed the coast of the Sunderbuns about midnight of the 6th.
12	October 30th and 31st	Severe cyclone in the south of the Bay, accompanied with hurricane winds near the centre.	Struck the coast near Madras on the night of the 31st.
13	November 18th to 21st	Feeble storm in the Martaban Gulf of little importance.	Filled up and disappeared before it reached the coast.

Tables giving a brief statement of the storms which affected the Bay of Bengal coasts during the years 1888-89—contd.

No.	Date.	Character.	Coast affected.
14	November 24th and 25th	Small depression off the South Madras coast of little importance.	Passed inland across the South Madras coast of the night of the 24th.
15	December 12th to 14th	Small cyclonic storm of considerable intensity formed in the south of the Bay, and accompanied with heavy weather and severe squalls of cyclonic force and hurricane winds near the centre.	Struck the Madras coast near Negapatam.

The following table gives the action taken by the Bengal Reporter in warning the coasts affected by these storms :—

Date.	Hour.	Storm number.	Ports warned by cautionary telegrams.	PORTS WARNED BY SIGNAL.	
				When hoisted.	When taken down.
May 11th, 1888	9-40	1	Madras and Negapatam.		
June 3rd "	...	2	Madras and Negapatam.		
Do. " "	9-0	"	Akyab, Bassein, Rangoon and Moulmein.		
Do. 4th "	10-0	"	Chittagong, Chandbali, False Point, Pooree, Gopalpur, Bimlipatam, Vizagapatam and Balasore.		
Do. 10th "	10-30	3	Chittagong.		
July 1st "	11-55	4	Chittagong and Akyab.		
Do. 12th "	9-52	5	Chandbali, False Point, Pooree, Gopalpur, Calingapatam, Bimlipatam, Vizagapatam, Cocanada, Madras and Balasore.		
		"	Calcutta.		
		"	Saugor Island	13th July, 5-27 h.	Ordered to lower at 0-15 h., July 14th, by telegram.
		"	Mud Point	Do. 6-25 "	
		"	Diamond Harbour	Do. 5-50 "	
		"	Budge-Budge	Do. 4-49 "	
		"	Pooree	Ordered to hoist at 9-47 h., July 13th, and to lower at 0-15 h., July 14th.	
Aug. 24th "	1-20 A.M.	"	Calcutta.		
		"	Budge-Budge	24th Aug., 6-0 h.	Ordered to lower at 7-46 h., Aug. 25th. 25th Aug., 8-27 h. Do. 9-0 " Do. 11-2 "
		"	Diamond Harbour	Do. 9-47 "	
		"	Mud Point	Do. 3-40 "	
		"	Saugor Island	Do. 5-27 "	
Sept. 4th "	11-5	9	Chandbali, Pooree, False Point, Gopalpur and Balasore.		
		"	Calcutta.		
		"	Budge-Budge	6th Sept., 9-35 "	7th Sept., 6-45 "
		"	Diamond Harbour	Do. 9-47 "	Do. 7-35 "
		"	Mud Point	Do. 9-37 "	Do. 6-40 "
		"	Saugor Island	Do. 9-57 "	Do. 5-57 "
Do. 6th "	9-17	"	Calingapatam and Bimlipatam.		
Do. 13th "	10-45	10	Moulmein, Rangoon, Bassein and Tavoy		
		"	Calcutta.		
		"	Budge-Budge	14th Sept., 10-2 "	16th Sept., 14-37 "
		"	Diamond Harbour	Do. 10-27 "	Do. 15-24 "
		"	Mud Point	Do. 10-4 "	Do. 15-12 "
		"	Saugor Island	Do. 10-0 "	Do. 15-12 "
Do. 14th "	9-7	"	Akyab, Chittagong, Chandbali, False Point, Pooree, Madras and Balasore.		
Do. " "	22-0	"	Gopalpur, Calingapatam, Bimlipatam, Vizagapatam and Cocanada.		
		"	Pooree	Ordered to hoist by telegram sent off at 8-30 h., Sept. 15th.	Ordered to lower at 9-43 h., Sept. 16th.
		"	False Point		
		"	Chandbali		
		"	Balasore		
		"	Calcutta.		
Oct. 2nd "	10-10	11	Saugor Island	2nd Oct., 11-22 h.	7th Oct., 7-5 h.

Date.	Hour.	Storm number.	Ports warned by cautionary telegrams.	PORTS WARNED BY SIGNAL.	
				When hoisted.	When taken down.
Oct. 2nd 1888	10-10	11	Mud Point	2nd Oct., 10-57 h.	7th Oct., 7-5 h.
		"	Diamond Harbour	Do. 10-57 "	Do. 7-10 "
Do. " "	10-55	"	Budge-Budge	Do. 10-57 "	Ordered to lower at 5-48 h., Oct. 7th.
Do. " "	11-0	"	Akyab, Rangoon, Bassein, Moulmein, False Point, Chandbali, Balasore and Pooree.		
Do. " "	11-0	"	Madras.		
Do. 3rd "	10-28	"	Chittagong.		
Do. " "	10-46	"	Gopalpur, Calingapatam, Bimlipatam, Vizagapatam, Cocanada and Masulipatam.		
		"	Chandbali	Ordered to hoist at 11-30 h., Oct. 4th.	Ordered to lower at 5-50 h., Oct. 7th.
		"	False Point		
		"	Pooree		
		"	Balasore		
		"	Chittagong	Ordered to hoist at 6-53 h., Oct. 6th.	Ordered to lower at 5-50, h. Oct. 7th.
Do. 30th "	11-0	12	Madras.		
Do. " "	18-45	"	Vizagapatam, Bimlipatam, Cocanada and Masulipatam.		
Do. 31st "	19-42	"	Negapatam.		
Nov. 18th "	10-30	13	Madras and Rangoon.		
Do. 19th "	9-48	"	Akyab, Bassein, Moulmein and Tavoy.		
Do. 24th "	10-5	14	Negapatam.		
Do. " "	10-12	"	Madras.		
Dec. 12th "	10-50	15	Madras and Rangoon.		
Do. 13th "	10-45	...	Negapatam.		
Do. 14th "	9-25	...	Tuticorin.		
Do. " "	9-42	...	Trincomalee.		

A reference to the preceding tables will show that ample warning was given to the ports affected by the larger cyclonic storms of the year in the Bay of Bengal, and that the duty of warning the Madras, Bengal and Burmah ports was carried out in a satisfactory manner during the year.

36. No change was made in the working of the Bombay coast storm-warning system during the first four months of the year. When Mr. Chambers declined to accept the appointment of the Western India Reportership under the new conditions from the 1st August, it was necessary for me to make immediate arrangements for the performance of the Storm Signal work at Bombay. I was present at that time in Bombay under orders from the Government of India to endeavour to arrange, if possible, under certain defined conditions, for the retention of Mr. Chambers' services. Mr. Chambers refused to accept the appointment, except under conditions which the Government of India declined to agree to, and I was finally instructed by telegram from Simla to make other arrangements. As the question of a suitable successor had not been considered, the charge of the Bombay Meteorological Office was handed over to the Head Clerk, and the Bombay Storm Signal duties were taken up by the Simla Office, which was the only arrangement possible under the circumstances. I telegraphed instructions to Mr. Dallas, and forwarded a copy of the only printed memorandum on the subject drawn up by Mr. Chambers. I was not able to learn much during the very brief interval before I left Bombay about the exact objects of the Signal Service or the conditions and methods by which it had been previously worked. This was in part due to the fact that it was necessary for me to return as early as possible to Simla and arrange with Mr. Dallas for the performance of the new duties which the Simla Office had been obliged to undertake without any preparation, and literally at an hour's notice. The Bombay storm-warning system at that time employed only one signal—

a drum. Mr. Chambers, I ascertained, had supplemented this by the use of cautionary telegrams, but these were apparently intended only for the information of the Port Officers, and were not necessarily communicated to the shipping by any recognized methods. It appeared to both Mr. Dallas and myself, when we had fully considered the system we had undertaken to work, that it was defective in several important respects, and that a storm warning system for an important group of ports like Bombay, Karachi, &c., on an open coast of a large ocean liable to tropical cyclonic storms of great intensity, ought to fulfil two objects, *viz.*—

1st.—That of warning the port authorities and the shipping in the ports of the approach of a cyclonic storm or cyclone to the neighbourhood of the port, in order that the necessary precautions to ride out the gale may be taken.

2nd.—That of warning the shipping in the ports of the existence of cyclonic storms in the Arabian Sea, and more especially of those passing over or near the two great steamer tracks between Bombay and Karachi on the one hand, and Aden on the other. Such information would probably enable steamers leaving either of these ports to modify their course early so as to avoid the cyclonic storm, the existence of which had been notified to them.

These two objects are not only quite different, but it is evident that to use one signal to indicate—either the existence of a storm which is approaching Bombay or Karachi, or the existence of a storm which is not likely to approach to Bombay, but which is giving very stormy weather out at sea in the part usually passed over by vessels leaving that port, would only lead to confusion.

37. The difficulties arising from the use of one signal only are specially great in the case of the west coast south of Surat. For cyclonic storms which originate in the Bay of Bengal occasionally cross the Peninsula and pass out as disturbances which develop again into cyclonic storms in the Arabian Sea. Such disturbances or storms, although they may give a high sea, rarely, if ever, give a gale to the west coast ports south of Bombay, as they are protected by the wall of the West Ghâts from the disturbance or storm as it passes out into the Arabian Sea. If such a disturbance be transmitted westwards across the West Ghâts and give rise to stormy weather in the Arabian Sea, its effects are hence usually not felt to any serious extent at the coast ports, although it may give cyclonic winds at some distance out to sea. The existence of such storms is known days before they begin to influence the weather in the Arabian Sea, and there is no difficulty in warning the west coast of the passage of such a disturbance. If a Storm Signal be hoisted at a west coast port during such weather, its intention and meaning is evidently to indicate probable stormy weather off that port, and not at the port itself. Unfortunately, if as has hitherto been the case, only one signal be available, it might be interpreted to mean the approach of bad weather to that port itself.

38. Both Mr. Dallas and myself at once perceived the difficulties of working such a system satisfactorily, more especially as there was nothing on record which defined clearly the storm-warning duties of the Bombay Storm Signal Service. We therefore resolved to work it as prudently and carefully as was possible, and to err rather on the side of giving

ample warning by the only signal that was at our disposal. I was so impressed with the inadequacy and imperfection of the system that I thought it advisable to take the earliest opportunity of placing it on a proper footing. Mr. Dallas was absent from Simla in September inspecting certain stations, and I was obliged to send him to Calcutta in October to take up Mr. Pedler's duties, as that officer was in a weak state of health, and the doctor recommended short rest and change. Almost immediately after Mr. Dallas returned to Simla, I went to Karachi in the beginning of November to ascertain whether the changes I had in view for the improvement of the West India Coast Storm Signal Service would be acceptable to the Port authorities there, or what modifications might be considered necessary. On my return to Simla at the end of November I sent Mr. Dallas down to Bombay, one of the objects of the visit being to discuss the question of the improvement of the storm-warning system with Sir Henry Morland, Port Officer, and other authorities. I thus ascertained not only that the Port Officers of Bombay and Karachi considered the system in force very imperfect, but also learnt the improvements and extension they considered necessary to place it on a proper footing. Having thus obtained full expression of the opinions of the most competent and interested authorities at the two ports chiefly affected by the question, I sent in to Government on the 21st December a letter directing its attention to the imperfections of the West Coast of India Storm Signal Service, and suggested two methods by either of which it might be improved and placed on a proper footing. The first was the extension of the system in force for warning the Burmah, Bengal and Madras ports to the Bombay ports (thus securing uniformity of system round the coast), and the second was the adoption of a more elaborate system proposed by Sir Henry Morland adapted to the conditions of the West India coast, and similar in many respects to the system employed by the English Meteorological Office in warning the British coasts. I urged the necessity of early consideration and selection by the authorities at Bombay of the system which appeared to them to be most satisfactory, and added that, although I considered uniformity of great importance in such matters, I thought that it was still more important to introduce a system which was specially adapted to the conditions and requirements of the coast for which it was desired and intended, and that, on these grounds, I considered Sir Henry Morland's scheme the most suitable. My letter was sent for consideration to the Bombay Government, and after the Commercial and Port authorities interested had been fully consulted, it was decided that Sir Henry Morland's scheme was most satisfactory. When I was in Bombay in May last I drew up, in consultation with the Acting Port Officer, Captain Bean, the details of the scheme, and submitted them very shortly afterwards to Government. Until this has been fully sanctioned, the Simla Office is obliged to carry out the warning of the west coast by an imperfect system based only on the use of one signal. Captain Bean suggested, when I was in Bombay, that, pending the introduction of the new system, the single available signal should be only hoisted at that port in the case of cyclonic storms passing over or near to the port, but that the Simla Office should telegraph freely concerning the existence and probable character of cyclonic storms out at sea. If this were done, he would arrange that these telegrams should be posted in a conspicuous position for the information of the Captains of vessels, and every effort made to communicate them to those interested. I have therefore adopted this arrangement for working the West Coast of India Storm Signal Service, pending the sanction and introduction of the improved system.

39. The following tables give a brief statement of the storms affecting the Bombay coast during the year and the action taken to warn the Bombay ports :—

No.	Date.	Character.	Coast affected.
1	May 26th to 29th . . .	Small depression off the Malabar coast.	Filled up on the 29th without crossing or advancing along coast.
2	June 4th to 12th . . .	Strong winds approaching in force to a gale on the Bombay coast.	Depression filled up, and apparently no cyclone formed at sea.
3	November 2nd to 9th . . .	Disturbed weather for some days, followed by a cyclonic storm which advanced N. N. E. Hurricane winds near the centre.	Crossed coast of Kathiawar on the morning of the 9th. The Coasting Steamer <i>Vaitarna</i> was lost during this storm.

ACTION TAKEN.

Date.	Storm.	Ports warned by cautionary telegrams.	PORTS WARNED BY SIGNAL.	
			When hoisted.	When taken down.
May 26th, 1888 . . .	1	Mangalore, Calicut and Cochin.		
		Cochin, Calicut, Mangalore.	1st November . . .	3rd November.
November 1st, 1888 . . .	3	Karwar, Kumta . . .	1st " . . .	4th "
		Vingurla, Goa . . .	3rd " . . .	4th "
		Bombay, Ratnagiri . . .	3rd " . . .	5th "
		Karachi, Bhavnagar and Daman.	9th " . . .	10th "

40. During the last storm the *Vaitarna* coasting steamer, with 600 native passengers, was lost. A Court of Enquiry was subsequently held, which called the attention of the Government to the following defects :—

- (a) The want of a proper system of meteorological observations on the coast of India.
- (b) The want of a proper system of exhibiting storm-warning signals on the coast of India.

It also recorded the opinion—

- (c) That if a proper storm-warning system had been in force with communication to most of the northern ports, intimation could have been conveyed in time to have enabled the *Vaitarna* to avoid the cyclone.

In addition to these three points the following were suggested by the evidence and subsequent remarks on the evidence :—

- (d) Whether the Simla Office with the system then in force gave as full warning and information to merchants and shippers in Bombay of the storm in question as could reasonably have been expected.
- (e) Whether the Bombay storm-warning system then in operation was defective and unsatisfactory, and also whether the India Meteorological Department was entirely or mainly to blame for this state of affairs.

The following gives a brief summary of my reply to Government on each of these points :—

- (a) That there is a fairly complete and satisfactory system of observations along the coast of India, but the Kathiawar coast was at that time imperfectly represented.

- (b) That there is a proper and satisfactory system for warning at least three-fourths of the coast of India, but that the Bombay system was at the time of the *Vaitarna* disaster defective. The India Meteorological Department was however endeavouring to remedy the defect previous to the disaster.
- (c) That if a proper and complete system for warning the Bombay (including the Kathiawar) coast had been in force at the time, it almost certainly would not have enabled the *Vaitarna* to weather the storm, as she was too lightly built to encounter a cyclonic storm and was navigating a portion of the coast where there is no shelter, and the Captain was apparently more or less ignorant of the laws of storms. It is, moreover, doubtful whether any system of storm signals would be of much use to vessels of the *Vaitarna* build navigating the Kathiawar coast.
- (d) The Simla Office gave as full warning of the position and character of the storm to the West Coast Ports by means of signal and telegrams as could reasonably be expected, more especially when the circumstances under which the Simla Office was performing that duty at that time are taken into consideration.
- (e) Neither the Bombay authorities nor Mr. Chambers ever called the attention of the Meteorological Department or the Government of India to the defects of the Bombay meteorological and storm-warning services so far as the Kathiawar coast was concerned. The Simla Meteorological Office, partly at the instance of the Government of India, and partly on its own knowledge of the defects of the Bombay meteorological system, was on the other hand, doing its utmost to remedy the defects in that system before the *Vaitarna* disaster occurred.

41. The chief defects were—

- (a) The want of a local Daily Weather Report and Chart.
- (b) The defective character of the Bombay Storm Signal Service.
- (c) The defective representation of Kathiawar in our meteorological system.

The following is a brief statement of the action taken by the Department up to the present time (August 1889) to remedy these defects—

1st.—A local Daily Weather Report and Chart based on weather telegrams from 41 stations is now published and issued daily to the Bombay public, practically at no additional cost to the State. This result, it may be added, is mainly due to the action and liberality of the Bombay Chamber of Commerce. Its issue dates from the 19th of May 1889.

2nd.—The India Meteorological Reporter commenced to remedy the second defect last November, and has since submitted the complete details of a storm-warning system, the principles of which have been fully approved by the Bombay local authorities, and which is now under consideration of the Government of India for adoption.

3rd.—The India Meteorological Department, as soon as the third defect was brought to its notice, took practical measures to remedy it so far as it could by making or suggesting arrangements for the establishment of an observatory at Verawal and Storm Signal Stations at Verawal and Porebunder. It is not, however, possible to remedy this defect satisfactorily until telegraphic communication has been opened to Dwarka or Mandvi.

PART II.—DETAILS OF ADMINISTRATION.

OBSERVATORIES.

42. At the commencement of the year under report there were in all 161 observatories in India contributing registers of meteorological data to the Central and Bengal offices. 135 of these sent in registers to the Central Office and 26 to the Bengal office; the latter were utilized only in the preparation of the Bengal Provincial Daily, Weekly, and Monthly Reports.

43. Observatories were opened at Pooree, Nellore, Madras (Port Office), Cuddalore, and Tavoy on the following dates :—

Tavoy on 20th March 1888,
Pooree on 18th March 1888,
Nellore on 19th September 1888,
Madras (at the Port Office) on 7th January 1889,
Cuddalore on 1st March 1889;

and they have contributed observations regularly during the year 1888-89. These observatories were established mainly to furnish weather information, more especially during storms, for the use of the Bengal Meteorological Reporter, and to enable him to warn the Burmah and Madras coasts more effectively.

44. One observatory, that of Nancowry, was abolished during the year in consequence of the Government having decided to abandon the settlement at Camorta. The whole of the establishment, European and Native, was removed in November last, and the meteorological instruments sent to Port Blair and subsequently to Calcutta. The number of separate observatories working in connection with the Department at the end of the year and submitting registers of observations was 165.

45. As has already been explained, the Government of India sanctioned a series of changes which very largely modified the hours of observation, the method of paying observers, and the amount and character of the observations. These changes necessitated a corresponding alteration in the classification of observatories. According to the new classification, which was adopted from the 1st of January, observatories in India were divided into—

1st Class—The observatories of this class are either furnished with autographic instruments for recording pressure, temperature, humidity, rainfall and wind direction and velocity, either continuously or at intervals of ten minutes, or take special solar or actinometric observations.

2nd Class—At which observations are taken at 8 hours which (with one or two exceptions) are transmitted to Simla by weather telegrams and are included in the India Daily Weather Report, and also at 10 and 16 hours. These stations have contributed reliable observations taken at these hours during many years past, and their future observations at these hours will be utilized chiefly for the scientific discussion in the annual reports on the meteorology of India.

3rd Class—Observatories, which are of two kinds—

(a) Those at stations where there are telegraph offices and which record 8 hours' observations for transmission daily to Simla, Bombay or Calcutta, by weather telegrams.

- (b) Those at which there are no telegraph offices, and which continue to record 10 and 16 hours' observations, in some cases for inclusion in the annual report, and in others to furnish a series of eleven years' observations, and thus obtain monthly and daily means for these stations which shall be comparable with those already obtained for the second class observatories.

4th Class—At which observations of temperature and rainfall only are recorded.

46. The following gives the arrangement of the observatories according to this classification at the end of the year, *i.e.*, on the 1st of April 1889 :—

BENGAL AND ASSAM.

	Class.		Class.		Class.
Calcutta (Alipore)	. 1st	Bhagulpur (p)	. 3rd	Noakholly (p)	. 3rd
Berhampur	. 2nd	Bogra	. "	Nya-Doomka (p)	. "
Burdwan	. "	Burrisal	. "	Pedong	. "
Chittagong	. "	Buxar (p)	. "	Pooree (p)	. "
Cuttack	. "	Chupra (p)	. "	Purneah	. "
Dacca	. "	Chyebassa (p)	. "	Rampur-Bauleah (p)	. "
Darjeeling	. "	Commilla (p)	. "	Ranchee (p)	. "
Dhubri	. "	Dehree (p)	. "	Ranigunj (p)	. "
Durbhanga	. "	Dinagepur	. "	Rungpur (p)	. "
False Point	. "	Furreedpore (p)	. "	Serajunj (p)	. "
Hazaribagh	. "	Gya	. "	Tezpur	. "
Patna	. "	Jessore	. "	Calcutta (Chowrin- ghee)	. 4th
Saugor Island	. "	Julpigoree	. "	Demagiri	. "
Sibsagar	. "	Krishnaghur (p)	. "	Mongpoo	. "
Silchar	. "	Maldah (p)	. "	Tura	. "
Arrah (p)	. 3rd	Midnapore (p)	. "		
Balasure	. "	Motihari (p)	. "		
Bankoora (p)	. "	Mymensingh	. "		

NORTH-WESTERN PROVINCES.

	Class.		Class.		Class.
Allahabad	. 1st	Roorkee	. 2nd	Ghazipur	. 3rd
Agra	. 2nd	Bareilly	. 3rd	Gorakhpur	. "
Lucknow	. "	Benares	. "	Jhansi	. "
Meerut	. "	Chakrata	. "	Mussooree	. "
Ranikhet	. "	Dehra	. "	Pithoragarh	. "

PUNJAB AND KASHMIR.

	Class.		Class.		Class.
Lahore	. 1st	Peshawar	. 2nd	Kailang	. 3rd
Simla	. "	Chamba	. 3rd	Rawalpindi	. "
Ludhiana	. 2nd	Delhi	. "	Sialkote	. "
Mooltan	. "	Dera Ismail Khan	. "	Sirsa	. "
Murree	. "				

CENTRAL PROVINCES.

	Class.		Class.		Class.
Hoshangabad	. 2nd	Raipur	. 2nd	Saugor	. 3rd
Jubbulpore	. "	Chanda	. 3rd	Seoni	. "
Khandwa	. "	Pachmarhi	. "	Sironcha	. "
Nagpur	. "	Sambalpur	. "		

BERAR.

Akola	Class. 2nd	Buldana	Class. 3rd	Makhla	Class. 3rd
Amraoti	Class. 3rd	Chikalda	Class. "		

CENTRAL INDIA AND RAJPUTANA.

Jeypore	Class. 1st	Bickaneer	Class. 3rd	Neemuch	Class. 3rd
Ajmere	Class. 2nd	Indore	Class. "	Pachpadra	Class. "
Nowgong	Class. "	Mount Abu	Class. "	Sambhar	Class. "
Sutna	Class. "				

BOMBAY.

Bombay	Class. 1st	Kurrachee	Class. 2nd	Hyderabad	Class. 3rd
Belgaum	Class. 2nd	Poona	Class. "	Malegaon	Class. "
Deesa	Class. "	Ratnagiri	Class. "	Rajkot	Class. "
Jacobabad	Class. "	Sholapur	Class. "	Surat	Class. "
Karwar	Class. "	Bhuj	Class. 3rd		

MADRAS.

Bellary	Class. 2nd	Wellington	Class. 2nd	Kurnool	Class. 3rd
Cochin	Class. "	Bangalore	Class. 3rd	Madura	Class. "
Madras	Class. "	Calicut	Class. "	Madras (Port Office)	Class. "
Mercara	Class. "	Coconada	Class. "	Mangalore	Class. "
Salem	Class. "	Coimbatore	Class. "	Masulipatam	Class. "
Secunderabad	Class. "	Cuddalore	Class. "	Negapatam	Class. "
Trichinopoly	Class. "	Cuddapah	Class. "	Nellore	Class. "
Vizagapatam	Class. "	Gopalpore	Class. "	Rajahmundry	Class. "

BURMA.

Akyab	Class. 2nd	Bassein	Class. 3rd	Moulmein	Class. 3rd
Diamond Island	Class. "	Bhamo	Class. "	Tavoy	Class. "
Mergui	Class. "	Kindat	Class. "	Thyetmio	Class. "
Rangoon	Class. "	Mandalay	Class. "	Toungthoo	Class. "

BAY ISLANDS.

Port Blair	Class. 2nd	Cocos Island	Class. 3rd
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EXTRA INDIA.

Aden	Class. 2nd	Amini Divi	Class. 3rd	Katmandu	Class. 3rd
Leh	Class. "	Baghdad	Class. "	Seychelles	Class. "
Quetta	Class. "	Bushire	Class. "		

In the list of Bengal third class observatories the stations denoted by (p) at present contribute observations only to the Bengal Reporter. The remainder send daily weather telegrams to the Simla as well as to the Bengal Reporter.

47. The important Government observatories of Bombay and Madras are independent of the Department and publish separate annual reports for the information of Government. The following are voluntary observatories :—

1.—*Vizagapatam*, an excellent private astronomical and meteorological observatory established in 1871 by the late J. V. Guggarow, Esq., and now maintained by A. V. Nursingrow, Esq., F. R. A. S., F. R. G. S.

2.—*Jeypore*, an admirable observatory provided with a complete set of autographic instruments and maintained at the expense of the Maharajah of Jeypore.

3.—*Nowgong*, established under the voluntary system at the Rajcoomar College under the superintendence of the Principal of the College.

4.—*Tura*, established at the Dispensary under the voluntary arrangements sanctioned by the order of Government.

5.—*Demagiri*, established at the Dispensary under the voluntary system.

6.—*Pedong*, where the observations are taken by the Reverend Father A. Desgodins, S. J.

7.—*Mongpoo*, where temperature and rainfall observations are taken in connection with the Cinchona plantations under the superintendence of Mr. G. A. Gammie.

8. *Meerut*, maintained at the cost of the Municipality and kept in excellent order under the supervision of Dr. Moir, Civil Surgeon.

9.—*Ghasipur*, established at the opium factory under the charge of the Medical Officer.

10.—*Makhla*, established in connection with the Forest Department under orders of the Government of India, No. 1043 F. of the 22nd August 1877.

11.—*Cocos Islands*, where the observations are taken voluntarily by the light-house keeper with the sanction of the Chief Commissioner of Burmah.

48. It may also be mentioned that regular observations are taken on board the light-vessels at the entrance to the River Hugli in accordance with arrangements made by the Port Commissioners and are furnished regularly to the Department. They are chiefly utilized in the discussion of the cyclonic storms of the Bay of Bengal. Registers of observations were received from the following light vessels during the year.

F. L. V. Planet, stationed at the *Intermediate Station* from April to October 1888.

„ *Meteor*, stationed at the *Ridge Light Station* from April to October 1888 and at the *Mutlah Station* from November 1888 to March 1889.

„ *Canopus*, stationed at the *Mutlah Station* from April to November 1888.

„ *Hesperus*, stationed at the *Lower Gasper Station* from April to September 1888.

„ *Star*, stationed at the *Intermediate Station* in February and March 1889.

CHARACTER OF WORK AT OBSERVATORIES DURING THE YEAR.

49. FIRST CLASS OBSERVATORIES.—*Alipore Observatory*.—This observatory is the largest and most important under the direct management of the Department. It is furnished with the following autographic instruments, a Sunshine recorder, a Kew barograph and thermograph, a Beckley's anemograph, an Osler's anemometer and a Beckley's rain-gauge. All instruments that are issued to Indian observatories are carefully tested at this observatory, and their corrections ascertained before they are sent out for use. Another important part of its work is the dropping daily of two time-balls at 1 P.M. local mean time for the port of Calcutta. The work of the observatory was described in full detail in the Administration Report of 1886-87 (page 18) and need not be repeated. No change has been made either in the work or the establishment of the observatory during the year.

The self-registering instruments have worked very satisfactorily during the past year and the photographic traces have been almost without exception very clear and distinct and admit of easy measurement. The introduction of argento-bromide sensitized paper (at the suggestion of Colonel Waterhouse, R.E.) some time ago has greatly improved the character of the traces. The measurements from the traces of the barograph and thermograph have been compared with the eye readings of the standard barometer, and the wet and dry bulbs in the same manner as in the previous three years (*vide Adminis-*

tration Report of 1886-87, page 18). The following gives the mean differences for the past four years :—

	1885.	1886.	1887.	1888.
Mean difference between the standard barometer and barograph during the year (<i>i.e.</i> standard barometer minus barograph)	+ '025"	+ '026"	+ '027"	+ '026"
Mean difference between the dry bulb in the thermometer shed and the dry-bulb trace of the thermograph (<i>i.e.</i> thermograph minus shed dry bulb thermometer)	+ '4°	+ '5°	+ '6°	+ '7°
Mean difference between the wet-bulb in the thermometer shed and the dry-bulb trace of the thermograph (<i>i.e.</i> thermograph minus wet-bulb thermometer)	+ '6°	+ '5°	+ '7°	+ '8°

50. The number of instruments compared with the standards and verified during the year was considerably greater than in any previous year except 1886-87. This is in part due to gradual increase in the number of observatories and partly to more frequent recall of instruments from observatories, which is now done as soon as the observations telegraphed daily to Simla show that the instruments are no longer trustworthy. The number of instruments verified during the year is shown by the following table :—

Instruments.	1885-86.	1886-87.	1887-88.	1888-89.
	Number.	Number.	Number.	Number.
Barometers	42	52	52	74
Aneroids	27	10	15	16
Dry and wet-bulb thermometers	8	62	31	41
Standard thermometers	5	1	8	...
Maximum thermometers for air temperature	7	46	6	50
Minimum do. do.	27	55	21	45
Do. do. for nocturnal radiation	28	18	10	9
Solar radiation thermometers	55	20	20	5
Common thermometers	2	...	1	2
Boiling point thermometers . . . . .	...	6	2	...
Travellers' maximum and minimum thermometers, in pairs . . . . .	...	...	1	1
Sling thermometers	5	2	3	...
Sand-glasses . . . . .	...	...	...	16
Salinometers	1	...	...	1
Hydrometers . . . . .	...	...	...	1
Rain-gauges	17	4	2	...
Measure-glasses for rain-gauges	27	4	2	...
TOTAL	251	280	174	261

The total number of instruments compared and verified in the year 1888-89 was 261 and in the year 1886-87 was 280.

The following table gives a statement of the instruments received from England or returned from observatories or after repair from the Mathematical Instrument Department and issued (properly verified) during the past year to the Central Office for distribution to observatories when required :—

INSTRUMENTS.	Received.	Issued.
Barometers	62	52
Aneroids	18	14
Dry and wet-bulb thermometers	38	43
Maximum thermometers for air temperature	58	36
Minimum ditto ditto ditto	63	41
Ditto for nocturnal radiation	5	5
Solar radiation thermometers	5	3
Common thermometers	2	2
Sling ditto	1	...
Travellers' maximum and minimum thermometer, in pairs	1	1
Sand-glasses . . . . .	...	11
Anemometers	6	6
Salinometer	1	1
Hydrometer	1	1
TOTAL .	261	216

These numbers show a large increase on the corresponding numbers for the preceding year (*viz.*, 224 receipts and 161 issues).

51. The time signal work has been performed more satisfactorily during the past year than in any previous year. The time-ball on the semaphore tower, Fort William, dropped accurately on all days during the year without a single failure. The time-ball on the roof of the Port Commissioners' office was dropped on all days, Sundays and holidays inclusive, except during the period from the 26th August to 29th November 1888, when it was under repair, and on the days noted in the undermentioned list, when it failed to drop properly.

Dates of failure.	Nature of failure.
7th May 1888	} Defect in telegraphic communication.
19th June 1888	
26th June 1888	
21st July 1888	
24th March 1889	

52. *The Feypore Observatory.*—Was under the superintendence of Dr. Hendley for the whole year, and continued to work in its usual efficient manner. From the report

of the Superintendent it appears that, in addition to the regular daily observations, a nearly continuous record was furnished by the meteorograph during the whole year. An autographic record of sunshine was taken by means of a Stokes' Whipple sunshine recorder and observations of earth temperatures were made throughout the year at various depths down to 40 feet. As already stated, this observatory is independent and is maintained by the liberality of the Maharajah of Jeypore.

53. *The Allahabad Observatory*.—The following account of the condition of this observatory is taken from the Report of the Meteorological Reporter to the Government of the North-Western Provinces :—

"The self-recording meteorograph of the Allahabad observatory, which had, as mentioned in the last report, been sent to the makers for repairs, was received back in the hot weather of 1888 and was set up at the end of the rains. It was very rusty and needed a good deal of cleaning. After regulation it was found that it could not be got to work with the Menotti battery, as it had too high a resistance. At considerable expense a Fuller (bichromate) battery, such as is now used in the Telegraph Department, was substituted for the Menotti and found to work well for a while, but afterwards the instrument stopped at frequent intervals a few hours after being wound up, and throughout the remainder of the year, its performance was most unsatisfactory, and not more than half a dozen good plates (giving observations of 12 days only) were obtained during the whole period. Recently it has been found that the axis of the cylinder was not truly vertical, and after this fault was remedied the instrument worked much better. The bichromate battery was also found to lose power too rapidly, and it was found necessary to have recourse to the Menotti battery again, which was strengthened by the addition of several cells."

"The observations of temperature and humidity on the observatory tower are still continued, but those on the Muir College tower were discontinued as soon as the series for a year was complete. The sunshine recorder worked continuously throughout the year. As in the previous year, observations of earth temperature at various depths down to 9 feet were made and transmitted to Calcutta. Observations of the movements of upper clouds were also made whenever such clouds were visible."

The preceding remarks hence show that the meteorograph has up to the present time been almost an entire failure, and it is very doubtful whether it will ever give continuous satisfactory traces. It is also an imperfect self-registering instrument, as it does not give a continuous record, but only a record of observations at 10 minutes' intervals. If a further trial should prove that it is too delicate and complicated a piece of apparatus to be worked efficiently by the native staff of the Allahabad observatory, and without the assistance and frequent presence of a skilled European electrician, it will be very desirable and perhaps necessary to discontinue its use and revert to eye observations, and thus secure a fairly accurate and continuous series of observations, such as a first-class observatory ought to record.

53. *The Lahore Observatory*.—Under the new scheme the Punjab Meteorological Office was abolished from the 1st January 1889 and the clerks were utilized as observers in the observatory, which was elevated to first-class from that date. Dr. Dickson acted as Superintendent from the 1st April to 31st December 1888 when he resigned the post. The following self-registering instruments were brought into use from the 1st January 1889 :—

- 1.—Draper's barograph.
- 2.—Draper's sun thermometer.
- 3.—Draper's hygrometer.
- 4.—Beckley's self-registering rain-gauge (Casella).

Two new solar radiation thermometers, Nos. 60669 and 37977, by Negretti and

Zambra were brought into use from the 10th and 19th February 1889, respectively. As the tower for the accommodation of the wind-registering instruments was in course of erection during the year, it was not possible to commence wind registration by the Beckley's anemograph supplied to the observatory. Seven sets of eye observations of temperature, pressure, wind, &c., are now daily taken from the ordinary instruments in the observatory shed. These not only furnish the meteorological data utilized for current purposes, but are employed to determine the errors of the Draper instruments. In addition, observations of ground temperature and amount of sunshine were taken as hitherto. The hourly observations on four days of every month have been discontinued, as they were no longer required after the introduction of the continuous autographic instruments. The staff which consists of three observers, worked satisfactorily throughout the year. The observatory was inspected on the 2nd November 1888, and everything found to be in good order.

THE WORK OF OBSERVATION AT OTHER OBSERVATORIES.

55. I pointed out in last year's Administration Report, that the barometric observations were by no means satisfactory at many stations. The charting of the daily observations (reduced to sea-level) for the Daily Report, and the comparison of the readings with the corresponding mean or normal values of the day, furnish the Simla Office with the very best means of detecting errors of observation, whether occasional or long continued.

56. Long continued or persistent errors in the barometric observations (reduced) taken at Indian observatories are usually due to one or other of the following causes—

- (1) Use of incorrect or bad barometers ;
- (2) Incorrect determination of the height of the observatory above the sea-level ;
- (3) Adoption of incorrect methods of reading the instrument by the observer ;
- (4) Taking the observations at other times than the proper hours.

All observers (even those who are thoroughly acquainted with the work) are liable to make occasional errors in reading instruments. In the case of a good observer such errors do not exceed five or six in the year. A careless and hasty observer frequently makes as many in the course of a month. The most frequent errors of this kind made by observers are the following :—

- (a) Error of '05" or '10" in reading the barometer, due to counting incorrectly the divisions on the scale or vernier, or overlooking a small or large division or mark in taking the observation, as, for example, reading 29.753 instead of 29.853, &c.
- (b) Error of 5° or 10° in reading thermometers due to similar oversight.
- (c) Recording the wind direction the opposite to that by which it should be denoted *e.g.* recording wind as W. instead of E.

57. It is necessary to eliminate as far as possible from the records all erroneous observations. In certain cases, more especially when the errors are due to any of the causes noted above, it is possible in the majority of cases to ascertain, by comparison with the corresponding observations at neighbouring stations, the errors made by observers and to correct the readings. In other cases, where the readings are manifestly erroneous, it is generally not possible to determine the exact cause and amount of the errors, and all that can be done is to reject the observations in question. All observations are examined as tho-

roughly as possible in the central and provincial Meteorological offices for the purpose of eliminating errors, and when the errors in the observations exceed a certain rate per mensem the observers submitting them are fined. Erroneous observations are worse than useless, and their detection gives a considerable amount of trouble to the meteorological offices.

58. The following are a few of the more remarkable cases of erroneous observations detected during the year in connection with the Daily Report work :—

(1). *Hyderabad*.—The barometer readings from the commencement of the year up to November 1888 were almost invariably too high. This was found on inspection of the observatory to be due to the observer reading the barometer by an erroneous method. There were three barometers at this observatory, and it would appear from the statement of the observer that observations were made sometimes from one instrument and sometimes from another in the most irregular manner.

(2). *Moulmein*.—Erroneous barometric observations were submitted for some time. The observer was warned, but that produced no improvement. He was then fined, after which it was ascertained that the regular observer had gone on leave, and that an imperfectly trained substitute was performing the work.

(3). *Thayetmio*.—Erroneous barometric observations were submitted for some time, and it was found, after repeated enquiries, that they were due to the same cause as at Moulmein.

(4). *Rawalpindi*.—The barometric observations have for years been more or less unsatisfactory, and have never fitted in with those of neighbouring stations. This has been ascribed during the past ten years sometimes to defects of the barometer and sometimes to carelessness on the part of the observer. I visited the observatory in November last, and came to the conclusion that the only possible explanation was that the height of the observatory above sea-level had been incorrectly determined. A reference to the Survey Department partially confirmed this conclusion, but there is still an outstanding difference, the cause of which I have been unable to ascertain.

(5). *Mercara*.—The barometric observations at Mercara, like those of Rawalpindi when reduced to sea-level were uniformly too high when compared with those of neighbouring stations, and I pointed out some time ago to the Madras Reporter that it was almost certain the reported height above sea-level was erroneous. Miss Pogson visited the station, and obtained a fresh measurement of the height. The following extract from her report gives the result of her visit and of the re-determination :—

“As the pressure observations had been affected for some time past by some unknown error a careful investigation was made as to the cause. Doubts were entertained regarding the exactness of the height of the barometer above sea-level, and the Executive Engineer was asked to have the previous determination accurately verified by means of spirit-levelling from the nearest Trigonometrical Survey bench-mark. This was done, and the result shewed an error of nearly 103 feet, the height ascertained in May 1887 being 3883·7 feet, while the determination made in January 1889 made it 3780·69 feet above mean sea-level. The explanation of the error given by the Executive Engineer was that a mistake had been made in the bench-mark from which levels were taken.”

(6). *Hoshangabad*.—The barometric returns of the observatory were occasionally vitiated with mistakes, apparently due to great carelessness on the part of the observer. A recent inspection visit showed that this was the case, and that the observer had for some months past been very remiss in the performance of his duties, and was suffering from a disease which almost unfitted him for their proper performance.

(7). *Pachpadra*.—The barometric observations have been for some time past quite untrustworthy. Mr. Dallas, when he inspected the observatory in September 1888, found

that the instrument was in such a dirty condition that it was not possible to read it exactly. The observer had not been taught properly, and never adjusted the mercury surface in the cistern to the fiducial point. His readings since Mr. Dallas' visit have been much more satisfactory and are now apparently correct.

(8). *Saugor*.—The reduced readings at the station are almost invariably too low when compared with neighbouring stations, but the cause has not yet been fully ascertained. The observer is undoubtedly not so careful as he might be, and the errors are in part due to this.

(9). *Jhansi*.—The readings at this station were for some months during the year invariably too low. A new barometer was supplied, but the observer failed to adjust the mercury surface to the fiducial point. This defect has been only recently discovered on inspection of the observatory, and hence the observations of the past year are vitiated by a small variable error.

There are outstanding errors at certain stations, the causes of which have not yet been determined but are under investigation.

59. In connection with this subject it is interesting to note that there is a marked tendency to excessive local pressure at certain stations in isolated valleys, shut in such a manner as to prevent partially or entirely the lateral motion of the air.

60. The most striking case is that of Dehra in the Dehra Dun. It is one of the headquarters of the Survey Department, and its height above sea-level is very accurately known. It is only about 25 miles in a straight line from Roorkee, from which it is separated by the Sewaliks. The only two outlets of the valley of the Dehra Dun enclosed between the Sewaliks and the lower ranges of the Himalayas are the gorges through which the Ganges and Jumna pass into the plains. The height above sea-level of Roorkee is known with almost as great accuracy as that of Dehra. The following table gives the difference between the mean pressure (reduced to sea-level) at Roorkee and Dehra for the past four years:—

	1884.	1885.	1886.	1887.
January	+ 'c38	+ '025	+ '033	+ '017
February	+ '029	+ '028	+ '043	+ '025
March	+ '044	+ '040	+ '051	+ '042
April	+ '051	+ '053	+ '051	+ '033
May	+ '045	+ '060	+ '072	+ '045
June	+ '050	+ '060	+ '058	+ '076
July	+ '058	+ '046	+ '055	+ '048
August	+ '049	+ '054	+ '044	+ '040
September	+ '046	+ '052	+ '048	+ '037
October	+ '044	+ '056	+ '044	+ '042
November	+ '043	+ '042	+ '038	+ '050
December	+ '041	+ '029	+ '041	+ '040
YEAR	+ '044	+ '045	+ '048	+ '041

This table shows that pressure is invariably higher at Dehra than at Roorkee by amounts which differ considerably at different seasons, and which average '045" for the last four years. It is not probable that this is due to error in the determination of level or to alteration in the value of gravity due to attraction of the neighbouring mountain masses. The only apparently satisfactory explanation appears to be that the changes of pressure due to increasing temperature during the early part of the day only give rise to vertical motion, and that the horizontal motion which takes place in the plains is either not possible in such a valley as the Dehra Dun or takes place to a much more limited extent than in open situations in the plains of India.

61. Another interesting case is that of Ajmere as compared with Jeypore and Sambhar. Sambhar is in an open plain, Jeypore partially surrounded by hills, and Ajmere much more completely enclosed. The following table gives the monthly difference between the mean monthly barometer readings reduced to sea-level of the two pairs of stations, Ajmere and Jeypore and Ajmere and Sambhar:—

	Ajmere—Jeypore.				Ajmere—Sambhar.			
	1884.	1885.	1886.	1887.	1884.	1885.	1886.	1887.
January	+ '030	+ '027	+ '022	+ '023	+ '035	+ '028	+ '025	+ '023
February	+ '027	+ '035	+ '026	+ '024	+ '023	+ '038	+ '024	+ '017
March	+ '029	+ '021	+ '014	+ '021	+ '020	+ '031	+ '018	+ '024
April	+ '030	+ '019	+ '012	+ '007	+ '037	+ '034	+ '014	+ '008
May	+ '030	+ '004	— '004	+ '025	+ '042	+ '024	+ '005	+ '025
June	+ '044	+ '026	+ '012	+ '033	+ '040	+ '025	+ '009	+ '028
July	+ '018	+ '014	— '010	+ '014	+ '036	+ '024	+ '007	+ '027
August	+ '021	+ '019	+ '010	+ '013	+ '035	+ '033	+ '021	+ '031
September	+ '015	+ '006	+ '015	+ '017	+ '026	+ '012	+ '023	+ '030
October	+ '030	+ '029	+ '003	+ '015	+ '033	+ '030	+ '016	+ '017
November	+ '027	+ '039	+ '028	+ '019	+ '024	+ '029	+ '025	+ '012
December	+ '036	+ '026	+ '027	+ '017	+ '036	+ '023	+ '020	+ '015
YEAR	+ '028	+ '022	+ '013	+ '019	+ '033	+ '028	+ '018	+ '021

In considering these differences it should be remembered that the baric gradients are in opposite directions during the north-east monsoon and south-west monsoon in Upper India, and any difference due to this would nearly compensate over the whole year. The difference between Ajmere and Jeypore averaged '020" for the four years and for Ajmere and Sambhar '025". The only explanation I can suggest for this permanent difference is practically the same as that advanced in the previous case.

62. Salem and Bangalore in Southern India appear to present similar local increase of pressure due to their situation, the one being amongst hills with narrow openings and the other in a basin-shaped hollow.

It is, however, much more difficult to shew them in a table similar to the above, as the baric gradients in the two monsoon periods differ considerably in amount and direction and do not compensate.

63. There are not at present sufficient accurate data to discuss this local influence of valleys on pressure more fully. It is, however, an important and interesting question, more especially in connection with the Daily Weather Report and Chart. The baric lines, or isobars, laid down in these charts give differences of pressure which are generally assumed to be strictly related to the winds, either as cause or effect. In such cases as the above there are local differences of pressure due to geographical and topographical peculiarities of position which have nothing whatever to do with the maintenance of winds or air motion, and which are consequently out of place in weather charts as usually prepared and utilized, and it is a question whether these differences ought to find representation in the India daily weather charts, which are constructed and utilized mainly to show relations between wind rainfall and pressure. This question has, so far as I am aware, not been considered, but it is one which will probably have to be dealt with shortly in India.

64. The character of the work performed by the observers is on the whole improving and the observations submitted by about three-fourths of our observatories are probably as accurate as can be expected more especially when the conditions under which it is done are taken into consideration.

INSPECTION OF OBSERVATORIES.

65. The following table shows the amount of inspection done during the past year :—

Province.	INSPECTED BY		Native Inspector.
	Imperial Reporter.	Provincial Reporter or Sanitary Commissioner.	
BENGAL . . . . .	.....	Arrah. Bhagulpore. Buxar. Chupra. Dacca. Durbhanga. Gya. Jessore. Kishnaghur. Motihari. Mymensing. Patna. Raneegunge.	Bogra. Dinagepore. Jessore. Julpigoree. Rampore-Beauleah. Rungpore.
NORTH-WESTERN PROVINCES AND OUDH. . . . .	.....	Chakrata. Dehra. Meerut. Mussooree. Roorkee.	
PUNJAB	Delhi. Lahore. Rawalpindi.	Sirsa.	
CENTRAL INDIA AND RAJPUTANA.	Indore. Neemuch. Pachpadra.		
CENTRAL PROVINCES. PRO- . . . . .	.....	Chanda. Hoshangabad. Jubbulpore. Khandwa.	

Province.	INSPECTED BY		Native Inspector.
	Imperial Reporter.	Provincial Reporter or Sanitary Commissioner.	
CENTRAL PROVINCES,— <i>contd.</i>	.....	Nagpur. Raipur. Pachmarhi Saugor.	
BOMBAY . . .	{ Hyderabad. Karrachee. Surat.		
MADRAS . . .	{	Bellary. Coimbatore. Cuddapah. Madura. Mercara. Negapatam. Salem. Trichinopoly. Wellington.	
BURMAH . . .	{	Moulmein. Rangoon. Thayetmio. Toung-hoo.	Bassein.

This makes a total of 56 observatories inspected during the year, or slightly more than one-third of the total number. It is less than usual for several reasons. Mr. Dallas went on privilege leave during the cold weather, and I was hence obliged to remain at Simla to carry on the Daily Report work. This in turn prevented Mr. Pedler from going on tour in the cold weather so frequently as he otherwise would have done. The changes in the Bombay Reportership also diminished the work of inspection in that Presidency. Finally, it was necessary to retain the Native Inspector, who was appointed in the beginning of the year 1889, in Calcutta during the months of February and March 1889, in order to perform the duties of Head Clerk during the absence of Babu Fanindra Mohan Basu, the permanent Head Clerk, on two months' privilege leave.

66. Of the 56 observatories inspected 42 were reported to be in good order, 8 (*viz.*, Patna, Jessore, Mymensingh, Hoshangabad, Coimbatore, Mercara, Raipur, and Chakrata) in fair order, and the remaining 6 (including Chupra, Bhagulpore, Rampore-Beauleah, Rungpore, Neemuch, and Hyderabad) were in a very unsatisfactory condition.

67. The following gives the inspection reports of these six observatories, partly to shew the difficulties the Department has to contend with in order to secure satisfactory and trustworthy observations:—

Chupra—was inspected by Mr. Pedler on the 24th March. He reported as follows:—

"The majority of the instruments were found to be in a disgraceful condition. Since the last inspection by Mr. Eliot on the 16th January 1888, when the condition of the observatory was reported to be good, the observer has apparently been disgracefully careless. The barometer had been shifted from its old position in the circuit-house to the Collector's office-room, where it remains suspended within a cage, but the scale of the instrument was found to have become oxidized, and the barometer was dusty. It has been arranged to transfer the charge of the observatory from the Sub-overseer, Public Works Department, to the Telegraph Department. Sites have been selected in the Telegraph compound for the thermometer shed and the rain-gauge. A place was

also selected for the barometer. The wind instruments will remain in their present position in the Road-cess Office. The permission of the Director General of Telegraphs having been obtained to the transfer, arrangements have been made for the early erection of the shed in the new position where the Telegraph Master will be the observer."

Bhagulpore.—Mr. Pedler visited this observatory on the 11th August, and reported as follows:—

"The instruments were found to have been so much neglected by the observer as to render accurate observations impossible. The barometer was out of plumb slightly, and although a cage has been provided for the instrument it was not kept locked. The thermometer cage was also left unlocked and the instruments were very dusty, and there was practically no water in the bottle for the wet-bulb thermometer. The maximum thermometer was rather dirty, and although it was condemned and a new one had been sent on the 1st July, yet on the 11th August the old instrument was still in use. The wind-vane was extremely stiff, and had evidently been without oil for some months, and thus the wind registration was quite untrustworthy. The anemometer was also equally bad. The observatory was in a disgraceful condition, and reflected great discredit on the observer, who was fined half a month's pay. On the abolition of the Executive Engineer's Division at Bhagulpore the charge of the observatory was made over to the Civil Surgeon, and his Clerk appointed observer from 15th January 1889, the observatory continuing to remain in the grounds of the charitable dispensary as before. It is hoped that with this change the condition of the observatory will improve."

Rampore Beaulah was inspected by the Native Inspector on the 19th June 1888, who reported—

"There has been no change in the position of any of the instruments since the last inspection. Most of the instruments were found to be out of order. The maximum thermometer had a column of mercury $1\frac{1}{2}$ " long detached from the main column; this was never added to the readings. The instrument was also very loose within the brass staples. The instrument was changed. The minimum thermometer had a deposit of four degrees of spirit in the top of the bore. This was put right, and the observer taught how to do this in case of future necessity. The observer was very slow. He was also wrong in framing his telegrams. He was taught how to frame the words correctly. Although the observatory was transferred to the Postal Department on the abolition of the Executive Engineer's Office, a section-writer of the Judge's Court was allowed to be the observer. This man has now been removed and the Post Master placed in charge."

Rungpore was inspected by the Native Inspector on the 10th June 1888, who reported as follows:—

"Visited the observatory at 9-45 A.M. No one arrived to take the observations up till 11-15 A.M. The observer was then sent for, but he reported that he was ill. On enquiry I was informed that the observer was a man of unsteady habits. It also transpired that he seldom came on Sundays to take the readings, and his observations for that day are probably suggested by his own imagination. His readings on week days, instead of being taken at the proper time, are recorded whenever it is most convenient to him. The condition of the observatory was exceedingly bad. The floor of the shed was overgrown with jungle. The anemometer was groaning from friction and the wind-vane stiff for want of oil. The observatory being 100 feet off the District Post and Telegraph Office, the duties of the observer were entrusted to the Post Master with the permission of the Postal Department. The barometer was removed from 3rd August 1888 from its former position in the cutchery to the Post Office."

Hyderabad was inspected by myself in November 1888. The observations sent by daily weather telegrams had been for months utterly untrustworthy, and I had written to the Bombay Reporter and the Superintendent, but without avail. The following remarks, describing the condition of the observatory, are taken from my inspection report:

"The observatory is situated near the jail on the highest part of a slightly elevated ridge of limestone on which the greater part of the town is built. The site is very open, and probably the absence of trees and vegetation in the neighbourhood contribute to the high temperatures recorded."

The shed was in fair order. It is of the usual Bengal form and unenclosed. The condition of the instruments and the methods of observation were exceedingly unsatisfactory, and it is hardly too much to say that the observations for the previous twelve months at least are utterly worthless.

The following were the chief defects:—

- 1st.—The observer read his small hanging barometer about '05" too high by adjusting the first division of the vernier (and not the zero line) to the top of the mercurial column;
- 2nd.—He inverted the maximum thermometer in the opposite way to what he should when setting it;
- 3rd.—The muslin of wet bulbs was quite dry and stiff at 11-30 A.M., when I first visited the shed;
- 4th.—The wind-vane was stiff and unworkable, and the north pointer indicated north-west, and not north;
- 5th.—The observer read the anemometer wrongly, inverting the use of the pointers, and used a peculiar method of calculating the total wind in 24 hours, which gave absurdly high velocities."

The observer ascribed his use of these erroneous methods to the previous observer, who had taught him before he left. It was hence necessary to spend two days at Hyderabad in teaching him. Fortunately he was quick and learnt the correct methods more rapidly than might have been expected.

The barometers are kept in the office-room of the jail. There were three barometers, *viz.* No. $\frac{32}{1808}$ Adie, No. 721 Casella Fortin, and No. $\frac{1}{1875}$ Adie, and there had apparently been much confusion in their use. The thermometers were all, more or less, dirty, especially the wet bulbs, and were thoroughly cleaned. The anemometer was also dirty, and was taken to pieces and carefully cleaned and oiled. The observer prepared the weather telegram readily. For some time previously he had taken 8 A.M. observations at Madras and not local time. The observatory was left on the whole in a satisfactory condition, and it depends on the observer, who now knows his work, whether he will continue to record carefully and correctly his observations.

The following remarks respecting this observatory are taken from Mr. Hutchinson's Administration Report:—

"The worthless nature of the observations from this station appears to have been fully realised in this office, and every endeavour made to convey to the observer by letters instructions as to the proper method of taking observations, no less than 13 letters and memoranda, together with a telegram on the subject of incorrect observations, having been sent to the Hyderabad observatory. These frequent communications do not, however, appear to have had any effect, and the observations continued to be worthless up to the date of Mr. Eliot's inspection. Mr. Chambers has not left on record an account of the circumstances which compelled him to allow so unsatisfactory a state of affairs to continue so long without his being able to arrange for an inspection of this observatory. When questioned by Mr. Eliot, the observer attributed his incorrect method of procedure to bad training by his predecessor, but this statement does not seem to be in accordance with facts, as the records of this office shew that the Hyderabad observatory was visited by Mr. F. Chambers in March 1888, at which time the predecessor of the present observer was in charge of the observatory, and had therefore full opportunity of asking for instruction on any point on which he might have been doubtful."

Neemuch—I visited for similar reasons to those which induced me to inspect Hyderabad. The shed was in very fair condition, but the majority of the instruments were very dirty. The observer I found had neglected his duties to a disgraceful extent, and there was very strong evidence that many of the recorded observations had never been

taken from the instruments, but had been supplied from his own imagination at his own house, in order to save himself the trouble of going to the observatory. Arrangements were made for transferring the observatory to a very satisfactory site at the Telegraph Office, and the Telegraph Master was appointed observer.

SPECIAL OBSERVATIONS.

68. Amongst the special observations taken at a small number of stations are—

1st.—Observations recorded by self-registering wind instruments or anemographs at 16 stations ;

2nd.—Solar and terrestrial radiation observations at 29 stations ;

3rd.—Seismic observations at Sibsagar and Silchar in Assam. It may, however, be noted that the methods adopted by Mr. Blandford in consultation with the Head of the Geological Survey for registering the intensity of earthquakes are far too rough, and that the instruments have failed to act in every earthquake that has occurred in Assam since these observations were initiated, and it is now proposed to discontinue them.

69. The following gives a list of the observatories at which anemographic observations were taken during the year, and also shews the amount and character of the work done—

STATION.	Anemograms supplied.	How much reduced and tabulated at Calcutta Office up to the end of official year.	Character of Anemograms.
Belgaum . . .	1st April 1888 to 31st March 1889.	1st April to 31st December 1888.	Faint, but measurable.
Chittagong . . .	1st April 1888 to 29th September 1888 and 7th October 1888 to 31st March 1889.	Ditto	Ditto.
Cuttack . . .	1st April 1888 to 31st December 1888.	Ditto	Indistinct.
Darjeeling . . .	5th April to 15th October, 22nd to 24th October, 27th October to 20th December, 21st to 25th December, 31st December 1888 to 18th February 1889, 24th February to 19th March, and 21st to 31st March 1889.	5th April to 31st December 1888.	Ditto.
Deesa . . .	1st April to 27th July and 4th August 1888 to 31st March 1889.	1st April to 31st December 1888.	Faint, but measurable.
Dehra . . .	1st April 1888 to 31st March 1889	Ditto	Ditto.
Dhubri . . .	1st April to 31st August and 9th October 1888 to 28th February 1889.	Ditto	Ditto.
Hazaribagh . . .	1st April 1888 to 31st March 1889	Ditto	Distinct.
Lucknow . . .	1st April to 18th May 1888 and 11th June 1888 to 31st March 1889.	1st April 1888 to 31st January 1889.	Ditto.
Mussooree . . .	1st April to 28th December 1888.	1st April to 28th December 1888.	Ditto.
Nagpur . . .	1st April to 10th May 1888, 30th May 1888 to 22nd March 1889, and 24th to 31st March 1889.	1st April 1888 to 31st January 1889.	Ditto.
Poona . . .	1st April 1888 to 8th January 1889.	1st April to 31st December 1888.	Indistinct.

STATIONS.	Anemograms supplied.	How much reduced and tabulated at Calcutta Office, up to end of official year.	Character of Anemograms.
Rangoon . . .	1st April to 17th August 1888 and 26th August 1888 to 31st March 1889.	1st April to 31st December 1888.	Distinct.
Ratnagiri . . .	1st April to 31st December 1888.	Ditto	Ditto.
Roorkee . . .	1st April to 3rd December 1888 and 11th December 1888 to 31st March 1889.	Ditto	Ditto.
Saugor Island . .	1st April 1888 to 31st March 1889	Ditto	Ditto.

The traces at Cuttack and Poona were unsatisfactory, but this was due to the instruments (Casella's embossing instrument) working badly. The traces sent by Darjeeling were very unsatisfactory, and this was apparently due to no fault of the instrument, but to carelessness on the part of the observer.

70. The following gives a list of the stations at which arrangements were made to take solar and terrestrial radiation observations daily throughout the year, and of the work actually performed during the year 1888-89 :—

Stations.	Period for which radiation observations were taken and sent in to the Central Office.
Aden (a) . . .	From August 1888 to March 1889.
Allahabad . . .	Throughout the year.
Bombay . . .	Ditto.
Calcutta (Alipore) . .	Ditto.
Chakrata . . .	From April to December 1888.
Coimbatore . . .	Throughout the year.
Darjeeling . . .	No observations taken.
Deesa . . .	Throughout the year.
Dehra . . .	From April to December 1888.
Dhubri (b) . . .	Ditto.
Ghazipur* . . .	Ditto.
Jeypore . . .	Throughout the year.
Lahore . . .	Ditto.
Leh . . .	Ditto.
Lucknow (a) . . .	Ditto.
Madras . . .	Ditto.
Mount Abu . . .	Throughout the year.
Murree (a) . . .	For April and May 1888; September 1888 to March 1889.
Nagpur . . .	Throughout the year.
Pachmarhi (a) . . .	Ditto. (January 1889 excepted).
Poona (b) . . .	Ditto.
Rangoon (a) . . .	Ditto.

* No grass thermometer.

(a) Grass thermometer only for April to December 1888.

(b) Grass thermometer, April 1888 to January 1889.

Stations.	Period for which radiation observations were taken and sent in to the Central Office.
Ranikhet (a) . . .	April 1888 to January 1889.
Rawalpindi (a) . . .	Throughout the year.
Roorkee (a) . . .	Ditto.
Silchar*	From April to December 1888.
Simla*	Ditto.
Wellington	Throughout the year.
Vizagapatam	Ditto.

* No grass thermometer.

(a) Grass thermometer only for April to December 1888.

Darjeeling and Rangoon sent in very unsatisfactory observations to the Central Office. Those furnished by other observatories were apparently correctly taken. Many of the instruments require re-verification, and the work of re-verification will be taken up as an important part of the work of inspection during the next two years.

METEOROLOGICAL OFFICERS AND OFFICE WORK.

71. The general administration of the meteorological observatories and offices in the different provinces, has been in the hands of the following officers during the year:—

Names.	Office.	Province.
J. Eliot, Esq., M. A., F. R. MET. S. (Offg.)	Meteorological Reporter to the Government of India	Central Office.
W. L. Dallas, Esq.	1st Assistant Meteorological Reporter to the Government of India	
Babu Hem Raj	Personal Assistant to the Meteorological Reporter to the Government of India	
A. Pedler, Esq., F. C. S. (Offg.)	Meteorological Reporter to the Government of Bengal	Bengal and Assam.
S. A. Hill, Esq., B. SC.	Meteorological Reporter to the Government of North-Western Provinces and Oudh	North-Western Provinces, Oudh Rajputana and Central India (part).
J. R. Holt, Esq., C.S. (Offg.)		
W. L. Dallas, Esq.	Meteorological Reporter to the Government of Punjab	Punjab.
F. Chambers, Esq.	Meteorological Reporter for Western India	Bombay, Berar, Rajputana and Central India (part).
S. A. Hutchinson, Esq.		
Miss Isis Pogson, F. R. MET. S.	Meteorological Reporter to the Government of Madras	Madras, Mysore, Coorg, and Hyderabad.
Dr. J. H. Loch	Sanitary Commissioner, Central Provinces	Central Provinces.
Dr. C. Little	Sanitary Commissioner, Berar	Berar.
Dr. D. Sinclair	Sanitary Commissioner, Burma	Burma.

Mr. Blanford was on furlough, and I acted for him during the whole of the year.

Mr. Dallas was on privilege leave from the 29th December to the 28th March.

Mr. Pedler officiated as Meteorological Reporter to the Government of Bengal during the whole of the year.

Mr. Hill went on furlough on the 2nd March 1889, and Mr. J. R. Holt acted for him during the remainder of the year.

Mr. Chambers left the Department on the reduction of the Western India Reporter-ship to a half-time appointment on 1st August, when Mr. Ganesh Sadasiv, Head Clerk of the Bombay Meteorological Office, took charge of the current duties of the office until the 7th November, when Mr. Hutchinson was appointed and took over charge.

72. The following table shows the number of registers sent to the several meteorological offices for reduction, verification, and tabulation during the first nine months of 1888-89:—

PROVINCE.	India, Calcutta.	Bengal.	North-Western Provinces.	Punjab.	Western India.	Madras.	Total.
Bengal and Assam	4	20	...	...	...	...	24
North-Western Provinces and Oudh	1	...	14	...	...	...	15
Punjab	2	...	...	11	...	...	13
Rajputana and Central India	1	...	5	...	4	...	10
Central Provinces	11	...	...	...	...	...	11
Berar	1	...	...	...	4	...	5
Bombay	1	...	...	...	13	...	14
Madras, Mysore, and Coorg	2	1	...	...	1	16	20
Burma	10	1	...	...	...	...	11
Bay Islands	3	...	...	...	...	...	3
Extra Indian	7	...	...	...	...	1	8
TOTAL	43	22	19	11	22	17	134

The list does not include the registers of the 28 provincial observatories in Bengal which were prepared and utilized in the Bengal Meteorological Office.

73. The following table shows the number of registers sent to the several meteorological offices for verification, reduction, and tabulation during the last three months of 1888-89, and after the changes described in paragraphs 3 to 15 of the present report had been effected:—

PROVINCE.	CALCUTTA.		SIMLA.	ALLAHABAD.	BOMBAY.	MADRAS.
	8 h. registers.	10 h. & 16 h. registers.	8 h. registers.	10 h. & 16 h. registers.	10 h. & 16 h. registers.	10 h. & 16 h. registers.
Bengal and Assam	46	18	...	...	...	...
North-Western Provinces and Oudh . . . . .	...	1	11	9	...	...
Punjab . . . . .	...	6	11	2	...	...
Rajputana and Central India	1	1	8	3	...	...
Central Provinces . . . . .	...	8	8	...	...	...
Berar . . . . .	...	1	2	...	3	...
Bombay	1	1	12	...	8	...
Madras, Mysore, and Coorg	2	2	21	...	...	7
Burma . . . . .	...	4	12	...	...	...
Bay Islands	1	2	...	...	...	...
Extra Indian . . . . .	...	8	1	...	...	...
TOTAL	51	52	86	14	11	7

The registers from the Madras and Jeypore observatories are furnished to this Department with all necessary reductions. Those received from the Colaba (Bombay) and Vizagapatam observatories required partial reduction in the Calcutta Office.

74. In Bengal, the North-Western Provinces and Madras the Reporters collect the rain-fall registers of the district and sub-divisional stations of their respective provinces. The

Bengal Reporter publishes weekly and monthly rainfall returns, the Allahabad Reporter weekly rainfall returns, and the Madras Reporter monthly rainfall returns in the respective provincial gazettes.

The number of rainfall stations sending returns to each of the above officers is as follows :—

Bengal	255 stations.
North-Western Provinces and Oudh	274 „
Madras	316 „

75. The Reporter for Bengal administers a system of storm warnings for the protection of the Burma, Bengal, and Madras ports. The Bombay system of storm warnings was carried on by the Reporter for Western India until the 1st August, since which date the work has been transferred to Simla.

The meteorological observations copied from the log-books of ships entering the port of Calcutta, which continue to be received, are tabulated in the Central Office, Calcutta.

Mr. Dallas has assisted me during the year in preparing the Daily Weather Report Chart, and also discharged the duties of the Meteorological Reporter for the Punjab.

76. The Provincial Reporters assisted cordially in carrying out the various large changes that have been effected during the year, and I am largely indebted to Messrs. Hill, Dallas and Pedler for valuable assistance and suggestion in connection with these changes.

77. The following is a return of the number of ministerial officers and menial servants in the several meteorological offices as it stood on the 1st April 1889 :—

	INDIA AND BENGAL.		North-Western Provinces.	Western India.	Madras.	Total.
	Calcutta.	Simla.				
Head Clerks	1	1	1	1	1	5
Inspector	1	...	...	...	...	1
Computers	2	1	...	...	...	3
Clerks and Copyists	7	...	1	...	2	10
Tabulators	21	11	3	6	...	41
Draughtsmen	3	3	...	...	...	6
Artisans	3*	...	...	...	...	3
Peons and menials	13†	7	2	2	2	26

* Paid from subscriptions to Bay of Bengal Daily Weather Report.

† 2 Paid " " " " "

78. A temporary establishment of twelve clerks was sanctioned by the Government of India, and employed from 1st April to 31st December 1888, to copy out the daily observations of pressure, maximum and minimum temperature, vapour pressure, cloud, and rainfall taken at all the observatories previous to March 1888, in order to enable daily means of these elements to be obtained for use in the India Daily Weather Report, and to enable a more accurate comparison of the current matters with the normal to be made than was possible hitherto by the use of monthly means only. This work was completed, and the daily sums and means for one month, *viz.*, January, were worked out by this estab-

lishment. Since then the calculation of the sums and means has devolved on the permanent establishment of the Calcutta Office, and those for February, March, and April were completed before the end of the year under report. Apparent errors of observations in past years were eliminated as far as possible.

79. Babu Fanindra Mohun Basu, head clerk of the India Meteorological Office, has not only controlled the office with his usual ability, but has assisted very materially in carrying out many of the changes. It is largely due to his management of the Calcutta Office that the changes, so far as they affected the Central Office, were carried out smoothly, expeditiously and satisfactorily.

To him and the chief computer Babu Nirduksha Kumar Ghosh was assigned the task of superintending the work of the temporary clerks engaged to collect previous observations into a form suitable for ready calculation of daily averages. They devoted much time and labour to the elimination of all erroneous and doubtful observations. The completion of this work in time to enable the daily normal averages to be utilized from the 1st of January 1889 is mainly due to their energy and zeal.

The Calcutta Office has done unusually good work during the past year. The Provincial Reporters all speak favorably of their respective offices.

80. Appendix A gives a list of the Government officials, libraries, observatories, societies, &c., to which the publications of the India Meteorological Department are presented, including those which send their own publications in exchange.

INSTRUMENTS.

81. The following table gives the return of the instruments in store at the beginning and end of the year and of those received and issued by the India Meteorological Office during the year to the various meteorological offices and departments, and includes the stock, receipts, and issues of the Alipore Observatory:—

Return of the Stock, Receipt, and Issue of Instruments for the year 1888-89.

INSTRUMENT.	In Store on 1st April 1888.	Received, 1888-89.	Issued, 1888-89.	In Store on 31st March 1889.
Barometers Observatory, Fortin's principle	9	34	17	26
Do. do., Kew do.	8	4	9	3
Do. Mountain portable tripod (Adie)	13	23	16	20
Do. Marine, Kew principle	20	6	5	21
Do. Negretti and Zambra (various)	7	5	4	8
Do. Aneroid	15	2	5	12
Hick's Barograph	1	...	...	1
Thermometers, standard, with attached scales	28	...	...	28
Do. do., without attached scales	6	...	...	6
Do. for Hygrometers (Kew pattern)	58	44	39	63
Do. Maximum for shade	74	38	37	75
Do. Solar <i>in vacuo</i> (self-registering)	38	9	14	33

Return of the Stock, Receipt, and Issue of Instruments for the year 1888-89—continued.

INSTRUMENT.	In Store on 1st April 1888.	Received, 1888-89.	Issued, 1888-89.	In Store on 31st March 1889.
Thermometers, Solar <i>in vacuo</i> (non-self-registering)	26	1	1	26
Do. do. not <i>in vacuo</i>	2	...	...	2
Do. Minimum for shade	43	80	57	66
Do. do. for radiation	22	6	3	25
Sling Thermometers	13	1	...	14
Chemical Thermometers	7	...	...	7
Six's Thermometers	7	...	...	7
Common Thermometers . . . . .	...	2	1	1
Travellers' maximum and minimum Thermometers, in pairs . . .	5	...	...	5
Frankland's Sun Thermometers	3	...	...	3
Boiling-point thermometers	7	...	...	7
Thermograph with Negretti and Zambra sets of recording thermo- meters	1	...	...	1
Pouillet's Pyrheliometers	1	...	...	1
Stewart's Actinometers (thermometers for)	7	...	...	7
Do. do. (chamber for)	1	...	...	1
Hodgkinson's Actinometers.	2	...	...	2
Herschell's do.	1	...	...	1
Regnault's Hygrometers	3	...	...	3
Daniel's Hygrometers	10	...	...	10
Halleur's do.	5	...	...	5
Pocket Spectroscope (Browning's)	1	...	...	1
Anemometers	43	35	34	44
Wind-vanes	5	45	17	33
Beckley's Anemographs	2	1	3	...
Casella's do.	3	1	3	1
Electrical Anemometers and Wind-vanes	3	...	...	3
Rain-gauges (Symons's), 5" diameter	124	2	16	110
Do. do. 6" do.	2	1	...	3
Do. do. 8" do.	3	...	...	3
Measure-glasses for 5" rain-gauges	183	...	4	179
Do. for 6" do.	10	1	...	11
Do. for 8" do.	3	...	...	3
Reading lenses	2	...	1	1
Sun thermometer stands	7	10	4	13
Radiation thermometers pads	5	2	1	6

Return of the Stock, Receipt, and Issue of Instruments for the year 1888-89—concluded.

INSTRUMENT.	In Store on 1st April 1888.	Received, 1888-89.	Issued, 1888-89.	In Store on 31st March 1889.
Barometer cages . . . . .	...	3	3	...
Thermometer cages	4	12	9	7
Do. do. for ships	14	1	1	14
Prismatic Compass	1	...	...	1
Sand-glasses (3 minute)	29	29	11	47
Sun-dial	1	...	...	1
Clocks . . . . .	...	3	2	1
Bottles for wet-bulb thermometers	104	2	9	97
Electrophorus	1	...	...	1
Filled tubes for Marine K. P. Barometers	12	...	7	5
Do. for observatory K. P. Barometers	27	...	12	15
Chain for Casella's embossing anemograph	100 ft.	...	...	100 ft.
Gauges for testing Symons's rain-gauges	1 pair	...	...	1 pair
Plummet	1	...	...	1
Bull's-eye lantern . . . . .	...	1	1	...
Scale, ivory . . . . .	...	1	1	...
Salinometer . . . . .	...	1	1	...
Bed-plates for anemometers . . . . .	...	25	2	23

LIBRARY.

82. Appendix B gives a list of the additions to the Library during the past year. Another double and single book case has been added to accommodate the increasing number of books in the Library, which is in good order, except that some of the books have been slightly spoiled by insects. A farash has been engaged from the 1st January to look continuously after the books and keep them clean and free from dust and insects. It has not yet been possible to undertake the re-arrangement and cataloguing of the books in a manner convenient for ready reference, but it is hoped this will shortly be done.

JOHN ELIOT,

Meteorological Reporter to the Government of India.

CALCUTTA,

The 30th August 1889.

APPENDIX A.

List of Recipients of the Publications of the Meteorological Office.

Adelaide	Meteorological Observatory.
Agra	Editor of the <i>Delhi Gazette</i> .
Algeria	Meteorological Service of the Ecole des Sciences d'Alger.
Akyab	Port Officer.
Allahabad	Secretary to the Government, North-Western Provinces and Oudh. Meteorological Reporter, North-Western Provinces and Oudh. Sanitary Commissioner, ditto ditto. Editor of the <i>Pioneer</i> .
Amraoti	Sanitary Commissioner for Berar.
Amsterdam	Commissioner, Hyderabad Assigned Districts.
Bangalore	Royal Academy of Sciences.
Batavia	Resident in Mysore.
Berlin	Inspector General of Forests, Mysore and Coorg. Magnetical and Meteorological Observatory. Royal Prussian Meteorological Institute. Geographical Society.
Bombay	Secretary to the Government of Bombay. Meteorological Reporter for Western India. Colaba Observatory. Sanitary Commissioner with the Government of Bombay. Bombay University. Asiatic Society of Bombay. Sassoon Mechanics Institute. Consul-General for Portugal in British India (for Coimbra Observatory). Editor of the <i>Bombay Gazette</i> . Ditto <i>Times of India</i> . Port Officer. Director of the Indian Marine. Secretary to Government, Marine Department. Superintending Engineer, Hyderabad Public Works Department.
Bolarum	Port Officer.
Bassein	Government Meteorologist.
Brisbane, Queensland	Royal Academy of Sciences.
Brussels	Royal Observatory.
Bucharest, Roumania	Meteorological Institute.
Budapesth	Observatory.
Calcutta	Private Secretary to His Excellency the Viceroy. Secretary to the Government of India, Revenue and Agricultural Department. Ditto ditto, Home Department. Ditto ditto, Public Works Department. Ditto ditto, Department of Finance and Commerce. Ditto ditto, Military Department. Secretary to the Government of Bengal, Revenue Department. Meteorological Reporter to the Government of Bengal. Surveyor-General of India. Geological Survey of India. Sanitary Commissioner with the Government of India. Ditto to the ditto of Bengal. Superintendent, Botanical Gardens, Calcutta. Asiatic Society of Bengal. Indian Museum. Calcutta University. Presidency College. Public Library. Editor of the <i>Statesman and Friend of India</i> .

List of Recipients of the Publications of the Meteorological Office—continued.

	Editor of the <i>Englishman</i> .
	Ditto <i>Indian Daily News</i> .
	Ditto <i>Hindu Patriot</i> .
Calcutta— <i>contd.</i>	Pat. Doyle, Esq., C.E., Editor, <i>Indian Engineering</i> .
	St. Xavier's College Observatory.
	The Alipore Observatory.
	Mint Master.
	Indian Association for the Cultivation of Science.
	Port Officer.
	Deputy Conservator, Port Approaches.
Chittagong	Port Officer.
Chandbali	Port Officer.
Cawnpore	Director of Land Records and Agriculture, North-Western Provinces and Oudh.
Cachar	Deputy Commissioner.
Cambridge	University Library (through H. M.'s Secretary of State for India).
Cambridge, Massachusetts	Harvard College Library.
Cape of Good Hope	Astronomer Royal.
Carlsruhe, Baden, Germany	Bureau für Meteorologie und Hydrographie.
Chemnitz	Royal Meteorological Institute.
Chatham	Royal Engineer's Library.
	Norske Meteorologiske Institut.
Christiania	Royal Observatory.
	Editor of the <i>Ceylon Times</i> .
Colombo	Ditto <i>Ceylon Observer</i> .
	Surveyor-General of Ceylon.
	Danske Meteorologiske Institut.
Copenhagen	Royal Danish Academy of Sciences.
	Meteorological Office.
Cordoba	National Academy of Science.
	Servicio Meteorologico de la Provincia de Cordoba.
Darjeeling	Conservator of Forests, Bengal.
	Editor of the <i>Indian Forester</i> .
Dehra Dun	Superintendent, Great Trigonometrical Survey.
	Forest School.
Dublin	Royal Dublin Society.
Dacca	Dacca College.
Dibrugarh	Deputy Commissioner, Lakhimpur.
	Scottish Meteorological Society.
Edinburgh	Astronomer Royal for Scotland, Royal Observatory.
	Scottish Geographical Society (through H. M.'s Secretary of State for India).
Florence	R. Biblioteca Nazionale Centrale di Firenze.
False Point	Port Officer.
Greenwich	Astronomer Royal, Royal Observatory.
Goa	Meteorological Observatory.
Goalparah	Deputy Commissioner.
	Ditto ditto, Kamrup.
Gauhati	Commissioner, Assam Valley Districts.
Giessen	Oberhessische Gesellschaft für Natur und Heilkunde.
	Deutsche Seewarte.
Hamburg	Deutsche Meteorologische Gesellschaft.
Havana	Real Colegio de Belen.
Hong-Kong	Observatory.
Hyderabad	Conservator of Forests, Sind Circle.
Indore	Agent to the Governor General for Central India.
Iowa, U. S.	Iowa Weather Service.
Jeypore	Maharajah's Observatory.
Jubbulpore	Civil Surgeon.
Katmandu	Resident at Nepal.
Khandwa	Civil Surgeon of Nimar.
Kohima	Deputy Commissioner, Naga Hills.
Kew	Observatory.
Kidderpore	Deputy Director, Indian Marine.

List of Recipients of the Publications of the Meteorological Office—continued.

Lahore	{	Secretary to the Government of the Punjab. Sanitary Commissioner ditto ditto. Conservator of Forests ditto ditto. Meteorological Observatory.
Leeds . . . . .	.	Yorkshire College (through H. M.'s Secretary of State for India).
Leipzig . . . . .	.	Geographical Society.
Lisbon	{	Observatorio de Infante d'Luiz. Academy of Science. Her Majesty's Secretary of State for India. Meteorological Council. Royal Society. Royal Asiatic Society (through H. M.'s Secretary of State for India). Northbrook India Club (ditto ditto ditto). Society of Arts. Institution of Civil Engineers. Royal School of Mines. Royal Meteorological Society.
London . . . . .	.	Admiralty Library. United Service Institution. British Museum (through H. M.'s Secretary of State for India). Editor of the <i>Philosophical Magazine</i> . Ditto <i>Athenæum</i> . Ditto <i>Nature</i> . Ditto <i>Symons's Monthly Meteorological Magazine</i> . Ditto <i>Westminster Review</i> . Organizing Committee of the Imperial Institution of the United Kingdom, the Colonies and India. Secretary to the Government of Madras. Ditto ditto, Public Works Department. Meteorological Reporter to the Government of Madras. Government Astronomer, Madras. Sanitary Commissioner, ditto. Madras University. Editor of the <i>Madras Times</i> . Ditto <i>Madras Mail</i> . Ditto <i>Christian College Magazine</i> .
Madras . . . . .	.	Government Central Museum. Assistant Director of Land Records and Agriculture, Government of Madras. Surgeon-General, H. M.'s British Forces. Ditto, with the Government of Madras. Presidency Port Officer. Conservator of Forests, Northern Circle. Ditto ditto Southern Circle. Revenue Survey Department.
Madrid . . . . .	.	Royal Observatory.
Magdeburg . . . . .	.	Observatory of the Magdeburg Zeitung.
Manchester . . . . .	.	Literary and Philosophical Society.
Manila . . . . .	.	Meteorological Observatory.
Mauritius . . . . .	.	Meteorological Society.
Melbourne, Victoria	{	Observatory. University Library. Public Library.
Mexico . . . . .	.	Central Meteorological Observatory.
Milan . . . . .	.	Royal Astronomical Observatory.
Mount Abu	{	Secretary to the Governor-General's Agent in Rajputana and Chief Commissioner of Ajmere-Merwara. Ditto ditto ditto ditto ditto ditto in the Public Works Department.
Monte Video . . . . .	.	Meteorological Central Observatory.
Moulmein . . . . .	.	Port Officer. Royal Observatory.
Munich	{	Royal Academy of Sciences. Geographical Society. Royal Meteorological Central Station.

List of Recipients of the Publications of the Meteorological Office—continued.

Nagpur	{	Chief Commissioner, Central Provinces.
		Sanitary Commissioner, ditto.
		Inspector-General of Education, Central Provinces.
		Meteorological Observatory.
Naini-Tal	{	Conservator of Forests, Central Provinces.
		Ditto ditto Central Circle, North-Western Provinces and Oudh.
New Haven, Connecticut	{	Connecticut Academy of Arts and Science.
		Editor of the <i>American Journal of Science</i> .
New York, U. S.	{	Prof. Loomis.
Nowgong (Assam)	{	Meteorological Observatory.
		Deputy Commissioner.
Oxford	{	Radcliffe Library.
		Radcliffe Observatory.
Paris	{	Observatoire Municipal de Montsouris.
		Editor of <i>La Nature</i> .
		Physical Observatory, Meudon.
		Bureau Central Météorologique de France.
Perpignan, France	{	Meteorological Society of France.
Perth, W. Australia	{	Observatoire Météorologique et Magnétique.
Pesaro, Italy	{	Meteorological Reporter.
Philadelphia	{	Magnetical and Meteorological Observatory.
Poona	{	Franklin Institute.
Prague, Bohemia	{	Conservator of Forests, Northern Circle, Bombay Presidency.
Puebla	{	K. K. Sternwarte.
Quebec	{	Colegio del Estado de Puebla.
Raipur	{	Literary and Historical Society.
Rangoon	{	Civil Surgeon.
		Chief Commissioner, Burma.
		Sanitary Commissioner, ditto.
		Conservator of Forests, Pegu Circle.
		Editor of the <i>Rangoon Times</i> .
		Chamber of Commerce, Burma.
		Port Commissioners.
		Port Officer.
		Agricultural and Horticultural Society.
		Central Meteorological Office.
Rome	{	Imperial Observatory.
Rio de Janeiro	{	Superintendent, Botanical Gardens.
Saharunpur	{	Observatorio Nacional.
Santiago	{	Deputy Commissioner.
Sibsagar	{	Ditto ditto.
Sylhet	{	Secretary to the Chief Commissioner of Assam.
Shillong	{	Ditto ditto ditto Public Works Department.
		Conservator of Forests, Assam.
		Deputy Commissioner, Khasi and Jaintia Hills.
		Director of Land Records and Agriculture.
Simla	{	Sanitary Commissioner.
Singapur	{	Assistant Quarter Master General, Intelligence Branch.
Stockholm	{	Principal Civil Medical Officer, Straits Settlements.
St. Petersburg	{	Nautisk Meteorologiska Byrån.
		Physical Central Observatory.
Strasburg	{	Imperial Geographical Society of Russia.
		Prof. H. Wld, Physical Central Observatory.
Sydney	{	Imperial University Library.
		Observatory.
Syracuse, Sicily	{	University Library.
Tasmania	{	Royal Meteorological Observatory.
Tiflis, Russia	{	Royal Society.
Tokio, Japan	{	Physical Observatory.
Toronto, Canada	{	Imperial Mining Office.
Turin	{	Meteorological Central Observatory.
		Meteorological Office.
	{	Royal Astronomical Observatory.
		Meteorological Society of Italy.

List of Recipients of the Publications of the Meteorological Office—concluded.

Tura	Deputy Commissioner, Garo Hills.
Tezpur	Deputy Commissioner, Darrang.
Upsala	Meteorological Observatory.
Utrecht	Royal Netherlands Meteorological Institute.
Vienna	K. K. Central-Anstalt für Meteorologie und Erdmagnetismus.
	K. K. Geologische Reichsanstalt.
	Imperial Academy of Sciences.
Vizagapatam	Dr. J. Hann.
	A. V. Nursingrow, Esq.
	Chief Signal Officer, United States Army.
Washington, U. S.	Smithsonian Institution.
	United States Naval Observatory.
	Hydrographic Office.
	Prof. Cleveland Abbe.
Wellington, New Zealand	United States Geological Survey.
	Colonial Museum.
Whalle (England)	Stonyhurst College Observatory.
Woolwich	Royal Artillery Library.
Zi-ka-wei, Shanghai	Magnetical and Meteorological Observatory.
Zurich	Central Meteorological Office.

Presentations to the Library from the 1st April 1888 to the 31st March 1889.

Place.	Donors.	Title of Work.
AJMERE-MERWARA .	Conservator of Forests . .	Progress Report of Forest Administration in Ajmere-Merwara for 1886-87.
ALGERIA . . .	Meteorological Service . .	Bulletin Météorologique de l'Algérie, 1st February 1888 to 31st January 1889. Quantités de Pluies recueillies en Algérie de l'année 1877 à l'année 1886 inclus. Observations Météorologiques du Réseau African, Année 1878 to 1885. Bulletin Mensuel, April 1887 to January 1888 and March 1888.
ALLAHABAD . .	Meteorological Office . .	Administration Report of the Meteorological Reporter to the Government of the North-Western Provinces and Oudh for the year 1887-88. Brief sketch of the Meteorology of the North-Western Provinces and Oudh and Eastern Rajputana for 1887.
ALLEGHANY . .	S. P. Langley, Esq. . .	Energy and Vision.
AMSTERDAM . .	Royal Academy of Sciences . .	Jaarboek voor 1886 and 1887. Verdeeling der Warmte over de Aarde door C. H. D. Buys Ballot. Verslagen en Mededeelingen der Koninklijke Akademie van Wetenschappen afd Natuurkunde Derde Reeks, Derde and Vierde Deel.
BATAVIA . . .	Magnetical and Meteorological Observatory.	Observations made at the Magnetical and Meteorological Observatory, Batavia, Vols. VIII and X. Rainfall in the East Indian Archipelago for 1887.
BERLIN . . .	Austrian and German Meteorological Society. A. Woeikof Dr. G. Hellmann Konigliche Preussischen Meteorologischen Institut. Wilhelm Von Bezold . . .	Meteorologische Zeitschrift, February 1888 to February 1889. Klima des Ben Nevis in N. W.—Schottland. Klimatologische zeit-und Streitfragen, II and III. Die Regen verhältnisse der Iberischen Halbinsel. Instruction für die Beobachter an den Meteorologischen stationen II, III, und IV Ordnung. Zur Thermodynamik der Atmosphaere.
BERNE . . .	Department de l'interieur de la confédération suisse.	Tableau graphique des observations hydrométriques suisses pour le Bassin du Tessin, Rhône, Limmat, Ruess, Aar and Rhin, July to December 1887, and January to June 1888.
BOMBAY . . .	Government Observatory . . Government of Bombay . .	Magnetical and Meteorological Observations made at the Government Observatory, Bombay, during 1886. Twenty-fourth Annual Report of the Sanitary Commissioner, Bombay for 1887.
BRISBANE . . .	Meteorological Observatory . .	Weather Chart of Australasia, 10th February 1888 to 18th January 1889. Meteorological Synopsis of the Brisbane Observatory for August 1887 to December 1888. Rainfall Summaries taken at stations in the Colony of Queensland during July 1887 to December 1888. Weekly Meteorological Synopsis of the Brisbane Observatory for April 1887 to February 1888.

Presentations to the Library from the 1st April 1888 to the 31st March 1889—continued.

Place.	Donors.	Title of Work.
BRISBANE— <i>contd</i>	Meteorological Observatory	Account of the Operations of the Weather Bureau of Queensland, and list of stations. Preliminary Report of the Government Meteorologist of Queensland for 1887.
BUCHAREST	Institut Météorologique de Roumanie.	Annales de l'Institut Météorologique de Roumanie, Tome. II 1886.
BUDAPESTH	Central Anstalt für Meteorologie und Erdmagnetismus.	Jahrbücher, XVI Band, Jahrgang 1886.
	A. Pedler, Esq.	Report on the Tornado at Dacca on 7th April 1888.
	Comptroller of India Treasuries.	Civil Estimates, 1888-89, Vols. I and II. Civil Budget Estimates for 1888-89.
	Director-General of Post Offices in India.	Indian Postal Guide for April and October 1888 and January 1889.
	Editor (Pat. Doyle, Esq.)	<i>Indian Engineering</i> , Volume III, Nos. 1 to 8 and 14 to 26, Volume IV, Nos. 1 to 26, and Volume V, Nos. 1 to 13.
	Geological Survey of India	Records of the Geological Survey of India, Volume XXI, Parts II to IV, and Volume XXII, Part I. A Bibliography of Indian Geology.
		Returns of the Rail-borne Trade of Bengal during the quarters ending the 31st December 1887, 31st March, 30th June, and 30th September 1888, and for the year 1887-88.
		The Cyclone in the Bay of Bengal, June 1882.
		Report of the Sanitary Commissioner, Bombay, for 1871.
		Medical and Sanitary Report of the Native Army of Bengal, 1870.
		Report on the Operations of the Central Committee, Famine Relief Fund, North-Western Provinces, 1868-69.
CALCUTTA		Mr. Cockerell's Report of the Famine of 1886 in Behar.
		Draught and Famine in the North-Western Provinces, 1868-70.
		Past Famine Report, North-Western Provinces.
	Government of Bengal	Survey Operation Report, Lower Provinces of Bengal, for the years ending 30th September 1854, 1857, 1858, 1860, and 1862. Map of Bengal.
		Administration Report, Bengal Presidency, for the year 1863-64 to 1865-66, 1867-68, and 1868-69.
		Cyclopædia of India and of Eastern and Southern Asia.
		Thornton's Gazetteer, Volume I.
		Report on the External Trade of Bengal with Nepal, Sikkim and Bhutan, 1887-88.
		General Report on Public Instruction in Bengal, 1887-88.
		Report on the River-borne Traffic of the Lower Provinces of Bengal for 1887-88.
	Government of India, Home Department.	Atlantic Local Coast Pilot Sub-Division 13, published by the Coast and Geodetic Survey Office, United States, America. The Navigation of the Atlantic Ocean. Published by the United States Hydrographic Office Navy Department, Washington.

Presentations to the Library from the 1st April 1888 to the 31st March 1889—continued.

Place.	Donors.	Title of Work.
CALCUTTA— <i>contd.</i>	Government of India, Home Department.	The American Nautical Almanac, 1890. Published by the United States Hydrographic Office Navy Department, Washington.
		Report of the Meteorological Council of the Royal Society for the year ending 31st March 1887. Published by the Meteorological Office, London.
		General Instructions to Observers of the Signal Service, 1887. Published by the Chief Signal Office, Washington.
		The American Practical Navigator, being an Epitome of Navigation and Nautical Astronomy, 1887. Published by the Bureau of Navigation, Navy Department, Washington.
		The Atlantic Coasters' Nautical Almanac for 1888. Published by ditto.
		The Pacific Coasters' Nautical Almanac for 1888. Published by ditto.
		United States of America, House Miscellaneous Documents, 2nd Session, 48th Congress, 1884-85, Volume IX. Published by the House of Representatives United States, America.
		Notice to Mariners. Published by the United States Hydrographic Office Navy Department, Nos. 1—16 and 30—52 of 1887.
		Senate Miscellaneous Document, 1st Session, 48th Congress 1883-84, Volume III. Published by the Senate of the United States, America.
		Senate Miscellaneous Document, 2nd Session, 48th Congress, and Special Session of Senate, 4th March 1885, Volume V. Published by ditto.
	Government of India, Revenue and Agricultural Department.	Senate Miscellaneous Document, 2nd Session, 48th Congress, and the Special Session, 1885, Vol. VII. Published by ditto.
		List of Civil Officers holding Gazetted appointments under the Government of India in the Home, Legislative, Foreign, and Revenue and Agricultural Departments, corrected to 1st January 1888.
		India Office List for 1887.
		Meteorological Observations made at Simla, 1841—45.
		Rules and Orders of the Governor General in Council regulating the conduct of public servants in respect to borrowing money, receipt of complementary addresses, and other matters.
		Administration Report of the Indian Marine for 1887-88.
		Report on the Condition and Proceedings of the Government Observatory, Colaba, for the year which ended with the 30th June 1888.
	Indian Association for the Cultivation of Science.	Administration Report of the Madras Observatory for 1887.
		Report of the 11th Annual Meeting of the Indian Association for the Cultivation of Science, held in April 1888.
	Inspector General of Forests	Review of Forest Administration in British India, 1885-86 and 1886-87.
	Meteorological Office, Government of Bengal.	Reports on the Administration of Bengal, for 1886-87 and 1887-88.
	S. R. Elson, Esq.	Tornadoes and Waterspouts.
		Cyclones and Currents.
	Trustees, Indian Museum	Meteorological and Nautical Observations, 1859—62, Melbourne, Victoria.
	Surveyor General of India	Report of the Great Trigonometrical Survey of India, Volume X.
		General Report on the Operations of the Survey of India Department for 1886-87.

Presentations to the Library from the 1st April 1888 to the 31st March 1889—continued.

Place.	Donors.	Title of Work.
CAIRO . . .	Egyptian Statistical Bureau .	Bulletin Hebdomadaire, Nos. 7 to 10.
CAMBRIDGE (MASS) .	Harvard College Observatory .	Second Annual Report of the Photographic Study of Stellar Spectra.
CAPE OF GOOD HOPE.	Meteorological Commission .	Report of the Meteorological Commission for 1884 and 1885.
CHEMNITZ . . .	Royal Meteorological Institute .	Jahrbuch für 1886, Abth 3 and 1887, I Hälfte Abth I and II.
CHRISTIANIA . .	Dr. H. Mohn . . .	Tordenvejreenes Hyppighed i Norge, 1867-83. Studier over Nedbørens Varighed og Tæthed i Norge. Jahrbuch des Norwegischen meteorologischen Instituts für 1887. Vejledning til Udførelse af Meteorologiske Iagttagelser ved det Norske Meteorologiske Instituts Stationer.
	Norske Meteorologiske Institut	Beobachtungs-Ergebnisse der Norwegischen Polarstation Bossekop in Alten, Theil II.
		Oversigt over Luftens Temperatur og Nedbør i Norge i Aaret, 1887 Samt Tabeller over Temperatur og Nedbør, 1883-87.
	University Observatory .	Zonenbeobachtungen der Sterne zwischen 64° 50' und 70° 10' Nördlicher declination.
COIMBRA . . .	Observatorio Meteorologico E. Magnetico.	Observações Meteorologicas anno de 1886 and 1887.
COLOMBO . . .	Surveyor-General of Ceylon .	Administration Report for 1887, Part II, Scientific, Meteorology.
CONSTANTINOPLE .	Imperial Meteorological Observatory.	Climatologie de Constantinople. Déduite de 20 Années d' observations.
COPENHAGEN . .	Institut Meteorologique Danois .	Bulletin Meteorologique du Nord, February 1888 to January 1889.
	Royal Academy of Sciences .	Oversigt, Nos. 3 of 1887 and 1 and 2 of 1888.
CORDOBA . . .	National Academy of Sciences .	Boletin, Tomo X, Entrega 2ª, Tomo XI, Entrega 1ª and 2ª.
	Oficina Meteorológica Argentina	Anales de la oficina Meteorológica Argentina, Tomo. VI.
COSTA RICA . . .	Instituto Meteorologico Nacional	Boletin Trimestral, No. 3, July to September 1888.
DEHRA DUN . . .	Editor	<i>Indian Forester</i> , April to December 1888.
	Forest School	Report on the Course of Instruction at the Forest School for 1887-88.
	Trigonometrical Branch, Survey of India.	Spirit Levelled Heights, No. 3, Madras Presidency. Season 1886-87.
DORPAT	Dr. Karl Weiranch . .	Neue untersuchungen über die Bessel'sche Formel und deren verwendung in der Meteorologie.
	Observatory	Privatbeobachtungen der Regenstation Alswig im Jahre 1886. Meteorological Observations, October 1887 to August 1888.
DUBLIN	Royal Dublin Society .	Scientific Proceedings, new series, Volume V, Parts 7 and 8; Vol. VI, Parts 1 and 2.
		Scientific Transactions, Vol. IV, Series II, No. 1.
EDINBURGH . . .	University	Introductory Lecture to the Agriculture Class.
GREENWICH . . .	Royal Observatory . .	Results of Magnetical and Meteorological Observations for 1886.
		Spectroscopic and Photographic Results for 1886 and 1887.
HAMBURGH . . .	Deutsche Seewarte . .	Wetterbericht, 1st March 1888 to 28th February 1889.
		Monatsbericht, October 1887 to August 1888.

Presentations to the Library from the 1st April 1888 to the 31st March 1889—continued.

Place.	Donors.	Title of Work.
HAMBURGH— <i>contd.</i>	Deutsche Seewarte	Die Ergebnisse der Wetterprognosen im Jahre 1887. Meteorologische Beobachtungen in Deutschland, Jahr. IX, 1886.
HAVANNA	Real Colegio de Belen	Observaciones Magnéticas y Meteorológicas, January to December 1886.
HONGKONG	Observatory	Annual Weather Report for 1887. Observations made at the Hongkong Observatory in 1887.
	Colonial Surgeon	Meteorological Observations taken at the Lock Hospital, Hongkong, for December 1882.
	William Doberek, Ph. D., Govt. Astronomer.	Meteorology of South-Eastern China in 1886.
IOWA	Iowa Weather Service	A few facts about the Iowa Weather Service. The Iowa Weather Service and how it is supported. Flag Signals of the Signal Service. Fifth Biennial Report of the Central Station of the Iowa Weather Service. The Climate of Southern Russia and Iowa compared.
		Re-election or Re-organization, Choice Selections from the recent History of the Administration of the State University of Iowa.
		Die Ergebnisse der Meteorologischen Beobachtungen im Jahre 1887.
		Meteorological Report of the Punjab for 1887-88.
		Meteorological Summary of the Punjab for March 1888 to January 1889.
KARLSRUHE	Central Bureau für Meteorologie und Hydrographie.	Report on the Meteorology of the Punjab for 1887-88.
LAHORE	Government of the Punjab	Mittheilungen des Vereins für Erdkunde zu Leipzig, 1887.
LEIPZIG	Meteorological Office	Historia dos Estabelecimentos Scientificos Litterarios e Artisticos de Portugal, Tomo X to XV.
LISBON	Vereins für Erdkunde	Memorias da Academia Real das sciencias de Lisboa classe de Sciencias Moraes, Politicas E Bellas-Lettras, Nova Serie—Tomo V, Parte II, Tomo VI, Parte I.
	Royal Academy of Sciences	Jornal de Sciencias Mathematicas Physicas e Naturaes, No. XLV.
	Farmer's Club	Journal, December 1887.
LONDON	Franz A. Velschon, C. E.	The Natural Law of relation between Rainfall and Vegetable Life and its Application to Australia.
	G. J. Symons, Esq.	Symons's Monthly Meteorological Magazine for March 1888 to February 1889.
	H. F. Blanford, Esq., F.R.S.	On the relations of the Diurnal Barometric Maxima to certain critical conditions of Temperature, Cloud and Rainfall.
	Kew Observatory	Report of the Kew Committee for the year ending 31st October 1888.
	Meteorological Office	Daily Weather Reports, 1st January 1887 to 30th June 1888.
		Meteorological Observations at stations of the second order for the years 1883 and 1884.
		Weekly Weather Report, Volume IV, Nos. 46-52; Volume V, Nos. 1-38. Hourly Readings of 1885, Parts II and III.

Presentations to the Library from the 1st April 1888 to the 31st March 1889—continued.

Place.	Donors.	Title of Work.
LONDON— <i>contd.</i>	Meteorological Office . . .	Monthly Weather Reports for January to April 1887.
		Report of the Meteorological Council to the Royal Society for the year ending 31st March 1887.
		Bulletin International Bureau Central Météorologique de France for 1887.
		Quarterly Weather Report, Part III of 1879.
		Charts shewing the Mean Barometric Pressure over the Atlantic, Indian, and Pacific Oceans.
	Royal Asiatic Society . . .	Synchronous Weather Charts of the North Atlantic, Parts III and IV.
		Contributions to our Knowledge of the Meteorology of the Arctic Regions, Part V.
	Royal Meteorological Society . . .	Journal, Volume XX, Parts II and III.
	Royal Meteorological Society . . .	List of Fellows of the Royal Meteorological Society, 1st March 1888.
		Quarterly Journal, Volume XIV, Nos. 65 to 68.
MADRAS . . .	Government of Madras . . .	Meteorological Record, Volume VII, Nos. 27 and 28; Volume VIII Nos. 29 and 30.
		Proceedings Nos. 261 to 273.
		The Eruption of Krakatoa and subsequent Phenomena.
MADRID . . .	Observatorio . . .	Journal Nos. 1843 to 1894 (wanting No. 1846).
		<i>Westminster Review</i> for April 1888 to March 1889.
MAGDEBURG . . .	Magdeburgischen Zeitung . . .	Administration Reports of the Forest Department, Madras Presidency for the year 1886-87.
MANCHESTER . . .	Literary and Philosophical Society.	Observaciones meteorológicas efectuadas en el observatorio de Madrid años 1882-83 and 1884-85.
		Resumen de las observaciones meteorológicas efectuadas en la Península y Algunas de sus islas adyacentes durante el año de 1883.
MELBOURNE . . .	Observatory . . .	Jahrbuch der Meteorologischen Beobachtungen der Wetterwarte Jahr V. 1886 and Jahr VI. 1887.
MEXICO . . .	Central Meteorological Observatory.	Memoirs and Proceedings, Volume X, 3rd series.
		Proceedings, Volumes III, IV, XXV, and XXVI.
		Monthly Record of Results of Observations in Meteorology, Terrestrial Magnetism, &c., taken at the Melbourne Observatory, for November 1887 to August 1888.
MILAN . . .	Astronomical Observatory . . .	Boletín del Ministerio de Fomento de la Republica Mexicana, Tomo IV., Nos. 1, 2 and 62; Tomo V., Nos. 7-14, 81-90 and 171-185; Tomo VI, Nos. 101-106 and 180-184; Tomo VII, No. 76, and Tomo X, Nos. 37-42.
		Boletín Mensual, Tome I, Nos. 1-7.
MONTE VIDEO . . .	Observatorio Meteorológico del Colegio Pio de Villa Colon.	Anuario del observatorio Astronómico Nacional de Tacubaya Año de 1889.
MONTSOURIS, PARIS . . .	Observatoire Municipal . . .	Publicazioni del Reale osservatorio di Brera in Milano, No. 32.
MUNICH . . .	Geographical Society . . .	Boletín Mensual, Año I, Nos. 1 to 3.
		Annuaire de l'observatoire Municipal de Montsouris pour l'an 1888.
		Jahresbericht der Geographischen Gesellschaft in München für 1887.

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Place.	Donors.	Title of Work.
MUNICH— <i>contd.</i>	Meteorological Central Station	Übersicht über die Witterungsverhältnisse im Königreiche Bayern February 1888 to January 1889. Beobachtungen der meteorologischen stationen im Königreich Bayern, Jahrgang X, Hefts 1 to 3.
	Royal Bavarian Academy of Sciences.	Sitzungsberichte der Mathematisch-Physikalischen classe 1887, Hefts 1 and 2. Abhandlungen der Mathematisch-Physikalischen classe. Sechzehnten Bandes Zweite, Abth.
MOSCOW . . .	J. Yarkovski	Hypothèse Cinétique de la gravitation universelle en connexion avec la formation des éléments chimiques.
NAGPUR . . .	Chief Commissioner, Central Provinces.	Resolution on the Management by Government of Private Estates in the Central Provinces during the year ending 30th September 1887. Returns of Rail-borne Traffic for the quarters ending 31st December 1887, 31st March 1888, and 30th June 1888, and for the year 1887-88. Report on the Nagpur Experimental Farm in the Central Provinces for 1887-88.
		Ricerche Numeriche sulla latitudine del R. Osservatorio di Capodi- monte, parte seconda, 1885. Il Cerchio Meridiano Reichembach-Heurtaux del R. Osservatorio di Capodimonte.
NAPLES . . .	R. Osservatorio di Capodi- monte.	
NEW HAVEN . .	Yale University	Reports of the Astronomical Observatory of the Yale University for the years 1886-87 and 1887-88.
	Connecticut Academy of Arts and Sciences.	Transactions, Volume VII, Part II.
NEW YORK . .	Meteorological Observatory	Annual Report for 1887. Abstract of Registers from Self-recording Instruments for January to December 1888.
		Bulletin International, 2nd March 1888 to 28th February 1889. Annales, 1884, Tome II, Parts I and II; 1885, Tome I; Tome II, Part I, and Tomes III and IV; 1886, Tomes I and II. Bulletin Mensuel, January to December 1888. Bulletin annuel de la commission météorologique du département des Bouches-du-Rhône, Années 1882 to 1886. Annuaire, October 1887 to August 1888.
PARIS . . .	Bureau Central Meteorologique de France.	
	Meteorological Society of France	
PERTH (WESTERN AUS- TRALIA).	Meteorological Reporter . . .	Meteorological Report for Western Australia for the years 1885, 1886 and 1887.
PHILADELPHIA . .	Franklin Institute	Journal, March 1888 to February 1889.
POLA . . .	Hydrographischen Amtes . . .	Meteorologische und Magnetische Beobachtungen, February 1888 to January 1889.
POONA . . .	Deputy Superintendent, Survey of India, In charge, Tidal and Levelling Party, Poona.	Tide Tables for the Indian Ports for the year 1889.
PUEBLA . . .	Observatory	Boletín de Estadística del Estado de Puebla, Tomo I, Nos. 27 to 47.
RIO-DE-JANEIRO .	Imperial Observatory . . .	Revista do Observatório, February to May, and September to Novem- ber 1888, and January 1889. Anuario for 1885, 1886, and 1887. Annales de l'observatoire Impérial de Rio-de-Janeiro, Tome III, Passage de Vénus 1882.

Presentations to the Library from the 1st April 1888 to the 31st March 1889—continued.

Place.	Donors.	Title of Work.
RIO-DE-JANEIRO — <i>contd.</i>	Barão De Capanema . . .	Boletins Mensaes do 1º observatorio Meteorologico da repartição dos telegraphos do Brasil, Vols. I and II.
RIPOSTO . . .	Osservatorio Meteorologico del R. Istituto Nautico.	Bollettino Mensile, February 1888 to January 1889. Bulletino Meteorico for June 1888 to February 1889.
ROME . . .	R. Ufficio Centrale di Meteorologia E. Geodinamica.	Del Potere Emissivo del Terreno e del vegetali e della temperatura interna di questi ultimi. Sismoscopi o Avvisatori Sismici. Due Nuovi anemometroscopi registratori dei fratelli Brassart. Il sismometrografo a tre componenti con una sola massa stazionaria. I sismometri presentemente in uso nel Giappone.
ROUSDON (DEVON) .	C. E. Peek	Meteorological Observations made at the Rousdon Observatory for the years 1885 and 1887.
SINGAPORE . . .	Colonial Secretary, Straits Settlements.	Annual Report on Meteorological Observations in the Straits Settlements for the year 1887.
ST. PETERSBURGH .	Physical Central Observatory .	Annalen des Physikalischen Central-Observatoriums, Jahr 1886, Theil II; 1887, Theil I. Repertorium für meteorologie, Band XI.
	Dr. H. Wild	Über die Winter-Isothermen von ost-Sibirien und die angebliche zunahme der temperatur Mit der Höhe Dasselbst.
STONYHURST . . .	College Observatory . . .	Results of Meteorological and Magnetical Observations for 1887. The Earth's Polar Floods in Perihelion. The Cause of Magnetism.
SUBATHU . . .	Rev. G. T. Carruthers . . .	The Cause of Light. The Cause of Terrestrial Magnetism. The Planets upon Cardioides.
		Egeson's Weather System of sunspot causality.
		Results of Meteorological Observations made in New South Wales during 1886.
SYDNEY . . .	Observatory	Results of Rain and River Observations made in New South Wales during 1887.
SYRACUSE . . .	Central Observatory . . .	Osservazioni Meteorologiche, Anno XI, Nos. 6 to 12, and Anno XII, Nos. 1 to 12.
TASMANIA . . .	Royal Society	Papers and Proceedings for 1887.
TIFLIS . . .	Physical Observatory . . .	Meteorologische Beobachtungen im Jahre 1886. Magnetische Beobachtungen im Jahre 1886-87.
		Annual Meteorological Report, Part II, 1886.
TOKIO . . .	Imperial Meteorological Observatory.	Report of an Expedition to Mount Fuji. Report of the Meteorological Observations in the Empire of Japan for the year 1883 and for January to October 1884.
		Monthly Weather Review, January to November 1888.
TORONTO . . .	Meteorological Office . . .	Report of the Meteorological Service of the Dominion of Canada for 1885.

Presentations to the Library from the 1st April 1888 to the 31st March 1889—continued.

Place.	Donors.	Title of Work.
TORONTO— <i>contd.</i>	Meteorological Office . . .	General Meteorological Register of Toronto for 1887.
TRIESTE . . .	Osservatorio Marittimo dell' i. r. Accademia di Commercio e Nautica.	Rapporto Annuale dell' Osservatorio Marittimo di Trieste, 1885, Vol. II.
TURIN . . .	Meteorological Society of Italy	Bollettino Mensuale dell' osservatorio Centrale del Real Collegio Carlo Alberto in Moncalieri, Serie II, Volume VIII, Nos. 2 to 12, and Volume IX, Nos. 1 and 2.
		Annuario Meteorologico Italiano, annos III and IV.
		Osservazioni Meteorologiche in Pallone, 1885-86.
		Alcune Notizie sul Terremoto del 23rd February 1887.
UPSALA . . .	R. Osservatorio Astronomico dell' Università di Torino.	Bollettino Meteorologico ed Astronomico, Annos III to IX.
	Dr. H. Mohn and H. Hildebrand Hildebrandsson.	Les Orages dans la Péninsule Scandinave.
	Meteorological Observatory . . .	Bulletin Mensuel, Volume XIX, annee 1887.
UTRECHT . . .	Royal Dutch Meteorological Institute.	Orage Accompagné de Trombes près Upsala.
VIENNA . . .	Dr. J. Hann	Nederlandsch Meteorologisch Jaarboek voor 1887.
	K. K. Central-Anstalt für Meteorologie und Erdmagnetismus.	Criticism on False Point Cyclone of 22nd September 1885.
	K. K. Geologischen Reichsanstalt	Wetterbericht, 11th February to 31st December 1888.
VIZA GAPTAM . . .	A. V. Nursing Row, Esq.	Jahrbücher, Jahrg 1887, Band XXIV.
WASHINGTON . . .	Chief Signal Office . . .	Verhandlungen, Nos. 2 to 18 of 1888 and Nos. 1 and 2 of 1889.
		Results of Meteorological Observations recorded at the G. V. Juggarow's Observatory, Vizagapatam, during 1887.
		Weather Chart of the United States of America for 7 A.M., for 18th to 24th September 1887, and for 12th February to 30th June 1888; and for 8 A.M. and 8 P.M. for 1st July 1888 to 31st January 1889.
		Tri-daily Weather Charts of the Signal Service of United States of America for April 1887 to March 1888.
		Charts showing the Rainfall in the United States for each month from January 1870 to December 1873.
		Summary and Review of International Meteorological Observations for January to December 1884, October 1886, and January to December 1887.
		Professional Papers of the Signal Service, United States of America Nos. V and XIII.
		Monthly Weather Review of the United States for June and August 1886, September 1887, and January to November 1888.
		Subject Indexes to Monthly Weather Review and Annual Reports of the Chief Signal Officer of the Army to 1887.
		Daily International Chart 9th to 31st October 1886, and 1st January to 31st December 1887.
		Report of the Chief Signal Office, War Department for 1886 and 1887, (Parts I and II).
		Contributions to the Natural History of Alaska.
		Report of the Expedition to Point Barrow, Alaska.
		Report upon Natural History Collections made in Alaska during 1877-81.

Presentations to the Library from the 1st April 1888 to the 31st March 1889—concluded.

Place.	Donors.	Title of Work.
WASHINGTON — <i>contd.</i>	Hydrographic Office	Pilot Chart of the North Atlantic Ocean, March 1888 to February 1889.
		The Pilot Chart of the North Atlantic Ocean.
		Waterspouts of the Atlantic Coast of the United States for January and February 1888.
		Nautical Monograph, No. V.
	Philosophical Society	Bulletin, Volume X.
	Smithsonian Institution	Smithsonian Report, 1885, Part II.
WELLINGTON	Colonial Museum	20th, 21st, and 22nd Annual Reports of the Colonial Museum and Laboratory.
		Studies in Biology, No. 3.
		Reports on the Progress of Geological Survey of New Zealand for 1885 and 1886-87.
ZI-KA-WIE	Magnetical and Meteorological Observatory.	Bulletin Mensuel, January 1887 to February 1888.
ZURICH	Swiss Meteorological Institute	Meteorologische Beobachtungen, August 1887 to June 1888.
		Annalen der Schweizerischen Meteorologischen Central-Anstalt, 1886.

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- American Journal of Science, March 1888 to February 1889.
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 Anleitung zu Wissenschaftlichen Beobachtungen Auf Reisen, Bands I and II.
 Annalen der Physik und Chemie, Nos. 4 to 12 of 1888 and Nos. 1 to 3 of 1889.
 Applications of Dynamics to Physics and Chemistry. J. J. Thomson.
 Black's General Atlas of the World.
 Boole's Finite Differences.
 Cartees Synoptiques Journalieres du Temps embrassant le Nord de l'Atlantique et une partie des continents avoisinants; publiés par l'Institut Meteorologique Danois et le Deutsche Seewarte, June to November 1884.
 Comptes Rendus de l'Academie des Sciences, Volume CVI, Nos. 10 to 26; Volume CVII, Nos. 1 to 27; Volume CVIII, Nos. 1 to 8.
 Cours de Physique de l'Ecole Polytechnique, Par M. Jamin, Tomes I to IV.
 Deutsche Rundschau für Geographie und Statistik, Volume X, Nos. 7 to 12; Volume XI, Nos. 1 to 6.
 Differential and Integral Calculus. Greenhill.
 Dynamics of a Particle. Tait and Steele.
 Elementary Applied Mechanics, Part II. Alexander and Thomson.
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 Elementary Treatise on Heat. W. Garnett.
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 Elementary Treatise on Steam. J. Perry.
 Elements of Astronomy. Ball.
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 Encyclopædia Britannica, Volumes XXIII and XXIV.
 Ferrer's Spherical Harmonics.
 Ganot's Natural Philosophy. E. Atkinson.
 Geodesy. A. R. Clarke.
 Geometry in Space. Nixon.
 Higher Trigonometry. J. B. Lock.
 Histoire des Sciences Mathematiques et Physiques, Tomes I to XII.
 History of Astronomy during the 19th Century. Clerke.
 Kiepert's Hand-Atlas.
 La Nature, Nos. 772 to 823.
 Lectures on Geography. Strachey.
 Lehrbuch der Meteorologie. Dr. A. Sprung.
 Mathematical Problems. J. Wolstenholme.
 Nature, Nos. 959 to 1010.
 Philosophical Magazine, April 1888 to March 1889.
 Physical Arithmetic. Macfarlane.
 Physical Measurements. Kohlrausch.
 Physical Optics. Glazebrooke.
 Plane Trigonometry. Todhunter.
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REPORT
ON
THE ADMINISTRATION
OF THE
METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA
IN
1889-90.

PART I.—GENERAL.

The present Administration Report is, as those of former years, divided into two parts. The first gives an account of the results of the more important sections of the work of the Department during the year and of the changes and additions which have been made to improve and extend its usefulness. The second part contains details of administration and describes the condition and working of the observatories and meteorological offices and the results of the inspection of observatories during the year.

RETIREMENT OF MR. BLANFORD.

2. Mr. Blanford retired at the expiration of his furlough on the 8th of May 1889. His connection with the Meteorological Department has extended over a period of 22 years. He was appointed Meteorological Reporter to the Government of Bengal in June 1867 and initiated the local meteorological system established in that area and the storm warning service introduced to protect the port of Calcutta after the experience of the cyclone of October 1864. When the Government of India recognized the necessity of combining the various provincial systems into a common Meteorological Department for the whole of India, Mr. Blanford was requested by the Government of India to draw up a report on the best method of effecting this change. His suggestions for the establishment of an Imperial Meteorological Department which should absorb the local meteorological systems were approved by Government, and he was appointed Meteorological Reporter to the Government of India to carry out his proposals. The series of his Annual Reports and papers written for the Indian Meteorological Memoirs form a most valuable contribution to meteorological science. Since his retirement he has published "A Practical Guide to the Climates and Weather of India, Ceylon, and Burma, and the storms of the Indian Seas," which gives an admirable summary of the results of meteorological observations taken in India up to the present time, and presents, in a clear and interesting manner, the more important features of the climates and weather in India.

3. The Government of India, in its review of the Administration Report of 1888-89, expressed its high value of his services in the following terms:—

"In conclusion I am to take this opportunity to record the high estimate which has been formed by His Excellency the Governor General in Council of the zeal and ability displayed, during the several years of his

incumbency of the office of Meteorological Reporter to the Government of India, by Mr. H. F. Blanford, who has now retired from the service, and who was practically the founder of systematic and uniform meteorological observation in India."

OBSERVATORIES.

4. The number of the meteorological observatories under the control of the Meteorological Department maintained by the Government of India at the beginning of the year was 154, distributed as follows:—

First class	4
Second class	53
Third class	97

5. Third class observatories were established at Khushab and Montgomery in the Punjab, Cawnpore in the North-Western Provinces, Veraval and Ahmednagar in Bombay and Mozufferpore in Behar. Observations were also obtained for the first time from the observatory at Trivandrum, maintained by the Maharajah of Travancore, and from that at Bhavnagar, maintained by the Thakur of that State.

6. The observatory at Tezpur, which was established four years ago to give information and meteorological data of Central Assam, has never worked satisfactorily. The observer was repeatedly fined, and every effort used to rouse him to a sense of duty, but with not much success, owing partly, at least, to the apathy of the district authorities who took no interest in the observatory. Finally, on the night of the 16th March 1889, the observatory was, according to the observer's statement, broken open and all the thermometers stolen. I therefore decided to close the observatory temporarily, in order to ascertain whether it would be possible to re-open it under more satisfactory conditions, or, if not, to utilise the savings effected by its disestablishment in opening an observatory at Cherrapoonjee or Shillong.

7. Voluntary observatories were established at Shortt's Island near Chandbally, and at Lungleh in the Chittagong Hill Tracts during the past year, and useful observations were obtained from these stations from 1st April and 9th July 1889 respectively.

8. The observatory at Zanzibar was closed from January 1885 to December 1888. I failed for some time to arrange for the re-commencement of the work of observation there, as the Political Agent was unable to recommend any one who was competent and willing to take the observations. Dr. Charlesworth, Medical Officer, at length volunteered to take them, and sent in excellent observations from January 1889 to February 1890. He was unfortunately seized with fever in March 1890 and ordered home. The observatory is hence again closed. The difficulty of maintaining such distant observatories is very great, and I am inclined to think that the amount at present assigned to the Zanzibar Observatory might be far more profitably spent in opening and maintaining observatories in Burma.

9. The observatory, established in the year 1882 by Mr. Blanford at the Seychelles, has been even more unfortunate. Fragmentary observations have been taken at intervals, a large portion of which were never sent in to the Meteorological Office. The only observations that have been received are for the brief period, June 1883 to January 1884, and even these are, so far as I can judge, of little value.

As I learnt that there was an observatory maintained by the Mauritius Govern-

ment, I wrote to Dr. Meldrum, Director of the Mauritius Meteorological Service, and proposed that the two observatories should be amalgamated, in order that the double pay might secure the services of an efficient observer. Dr. Meldrum consented and undertook to make the arrangement. I hope that by this change satisfactory observations will be obtained from that distant station in future.

10. The observations taken at Amini Devi in the Laccadive Islands, Aden in Arabia, Baghdad in Asiatic Turkey, and Bushire in Persia, have been satisfactory, and apparently accurately taken.

11. A set of instruments were supplied in March 1888 to Dr. Woolbert, Medical Officer attached to the Military Officer on special duty on the Perso-Afghan frontier, in order that a series of observations might be taken at Meshed on the Perso-Afghan frontier. Observations have been received commencing from September 1889, and are of very considerable interest.

12. During the year I took preliminary steps towards the establishment of observatories at Perim and Paumben. The former is much wanted in order to furnish meteorological data of the southern part of the Red Sea, of which Aden is not sufficiently representative, and the latter is desirable in connection with the Bay of Bengal Storm Signal Service. An observatory is urgently required on the coast between Negapatam and Cape Comorin, in order that the Bengal Reporter may have meteorological information for the Gulf of Manar, and thus be able to warn the ports of Tuticorin and Paumben satisfactorily. I visited Tuticorin some time ago, and found that the town was largely sheltered, and that an observatory there would be of little value. On the other hand, the light-house and the telegraph office at Paumben are in very open positions, and an observatory at either of these places would give very reliable information of any squally weather in the Gulf of Manar. I hope to be able to open both of these observatories (Perim and Paumben) during the present year. I am also endeavouring to re-establish the observatory at Nancowry in the Nicobars recently closed under the circumstances stated in last year's report. I learnt, when I was at Port Blair on inspection duty last March, from Colonel Cadel, Commissioner of the Andamans, that there was a Burmo-Chinese clerk left at Camorta in charge of the islands, and that he would perhaps be willing to take the observations. The island, I was told, is extremely unhealthy, and if the observatory were re-established, and the Burmo-Chinese clerk were appointed observer, the observations would probably be occasionally interrupted, as there is no one else in the island who would be able to learn to take the observations. Observations from this part of the Bay are of very great value, as they tend to throw light upon the origin of all cyclones which form in the south-east of the Bay and march to the Coromandel Coast, and hence I consider the re-establishment of this observatory, even under imperfect conditions of observation, a matter of considerable importance.

13. Additional observations are also much wanted in Burma in order to elucidate the meteorology of that area and ascertain the part it plays in deflecting the south-west current of the Bay of Bengal, and in producing variations in its strength and the distribution of rainfall in North-East India. It is, however, not desirable to open out new observatories in that province until railway or telegraphic communication has been extended to all the more important districts. Certain parts of India itself are also imper-

fectly represented in our meteorological system; for example, the north-west coast of Kathiawar, certain parts of the Deccan (North-East Hyderabad), the eastern districts of the Central Provinces and certain portions of Chutia Nagpur, Rajputana and Central India.

INSPECTION OF OBSERVATORIES.

14. A much larger amount of work was done than in the previous year. The Native Inspector, Babu Chandi Charan Chatterjee, appointed in January 1889, was almost solely employed in this work from the beginning of April until the end of August. During this period he inspected 23 observatories, and also visited Veraval, Cawnpore, and Mozufferpore with the object of selecting sites and making arrangements (so far as was possible on a first visit) for the establishment of observatories at these stations. He was offered an appointment in the Subordinate Executive Service in Bengal, and as it would give opportunities for promotion much better than he could possibly have in the Meteorological Department, he was allowed to transfer his services, with effect from 23rd September 1889. His transfer was a serious loss to the Department, as he was an active and intelligent officer, specially qualified in every respect for the work of inspecting observatories. I have arranged, with the sanction of Government, that Lala Hem Raj, my Personal Assistant, shall in future perform that part of the work of inspection which was previously assigned to Babu Chandi Charan Chatterjee.

ACTINOMETRIC WORK.

15. The actinometric work, which was formerly carried on at Mussooree and transferred to Simla in March 1889, was carried on during the past year in exactly the same manner as previously. The following is a statement of the work done during the year, which compares favourably with the results of the two previous years :—

MONTH.		Complete sets of Observations.	Incomplete sets of Observations.
April	1889 . . . . .	...	...
May	" . . . . .	...	...
June	" . . . . .	...	...
July	" . . . . .	...	...
August	" . . . . .	...	...
September	"	7	5
October	"	22	9
November	"	26	1
December	"	16	...
January	1890	2	11
February	" . . . . .	...	8
March	"	2	10

16. The results of these observations have been sent, in accordance with the standing arrangements sanctioned when they were first started, to the Solar Physics Committee.

I have received no communication from that Committee during the past three years, and hence do not know whether the observations have been taken to their satisfaction, or whether any valuable results have been obtained from them.

17. When General Strachey, who is a Member of the Solar Physics Committee, was in Calcutta, he suggested certain improvements and additional observations. These I shall endeavour to carry out so far as is possible with the present staff. I pointed out that it was very desirable that the observations should be carefully examined as soon as possible after they were taken, in order to ascertain and rectify without delay any sources of error on the part of the observers, and to suggest any desirable improvements in the method of taking them, suggested by experience. As these are special experiments made by means of an instrument only lately brought into use, this appeared to me especially necessary. I suggested that if this could not be done by the Solar Physics Committee, I should ask Mr. Hill, who has devoted much time to this part of the Science of Meteorology, to examine and report on the observations periodically. General Strachey approved of it, and accordingly I asked Mr. Hill to take up the observations of the past three years and report on their character. A summary of his remarks will be given in next year's Administration Report.

18. It may however be noted that Mr. Hill has already placed on record his opinion that the observations taken by Babu Nirbhai Singh, who was promoted to be Actinometric Observer when Mr. Shaw was transferred to the Survey Department, are, on the whole, very satisfactory. He is a careful and conscientious observer and carries out fully the various instructions that have been given for the proper performance of these special observations.

RAINFALL REGISTRATION.

19. The reasons in favour of the introduction of a uniform system of rainfall registration were fully explained in last year's Administration Report. A common hour, 8 A.M., was adopted in May last for rainfall registration. This was a most important step in advance towards the adoption of a uniform system. Previously to 1889 the Simla office collected special rainfall data for the information of the Government of India during the south-west monsoon period only. In 1889 a very considerable extension was made in the amount of rainfall data obtained from District Officers. The system, which was explained in the Administration Report of the year 1887-88, enables the Department to prepare rainfall charts and statements of a far more comprehensive character than hitherto, and to give an accurate and fairly complete view of the progressive distribution of rainfall over the country during the chief rainfall periods into which the year may be divided. Rainfall data are now collected during the whole year. A Weekly Summary is published in the *Gazette of India*, and rainfall charts, drawn by hand, are prepared weekly for the information of His Excellency the Viceroy and the Agricultural Department.

20. I submitted a letter on the 5th October 1889, suggesting the further changes that appeared to be desirable with a statement of reasons. The improvements suggested were—

1st.—The adoption of a common type of rain-gauge (*viz.*, Symons') for rainfall registration throughout India.

2nd.—The supply of the instruments by the Meteorological Office which should arrange that all rain-gauges are tested before issue.

3rd.—More frequent inspection of rain-gauge stations, and the submission of the reports of inspection to some controlling office.

4th.—The examination of all rainfall data for elimination of errors by duly qualified officers in different provinces, so that the rainfall data collected in different provinces of India may be strictly comparable in point of accuracy.

5th.—The annual publication of the rainfall data of the whole of India in a complete form for the use of engineers, irrigation officers, European meteorologists, and others interested in the rainfall statistics of India.

A memorandum forwarding these suggestions was sent to Local Governments and others for opinion. Replies were received, and I was requested to re-consider the suggestions I wished to make in the light of the opinions of the Local Governments, and the information contained in their replies. My final suggestions were submitted to the Government on the 15th May 1890. It is hence probable that the Government will issue orders during the present year and that the changes and improvements it sanctions will be made from 1st January 1891, as it is inconvenient to make general changes in such a matter as rainfall registration, except at the beginning of the year.

21. The preparation of the weekly rainfall data for the Weekly Weather Report published in the *Gazette of India* has necessitated the calculation of average weekly rainfalls for all districts of India. The available data in the Meteorological Office for the calculation of these averages were small in amount, and it appeared to be desirable to have this work carried out properly before the introduction of the new system. It was, therefore, determined to collect and to tabulate in a form, convenient for future reference, the whole of the available rainfall data of India.

22. Thirty temporary clerks were engaged, during the months of January and February 1890, to tabulate the data as they were obtained. Twenty-five were employed in the Calcutta office to copy the rainfall of the Punjab, the North-Western Provinces and Oudh, Assam, and the Central Provinces. The whole of the rainfall data of Bengal was tabulated by the Bengal Meteorological Office in the year 1883, and it was hence not necessary to copy the figures of that province. Five of the clerks were engaged at Bombay to complete the tabulation of the rainfall of that area, which was commenced and partially carried out during the period November 1888 to March 1889.

23. Miss Pogson, Meteorological Reporter for Madras, made arrangements for the tabulation of the whole of the Madras data.

24. It was necessary, in connection with this work, to enquire into the amount of available data for each province and the arrangements for the preservation of the rainfall records. The following gives a very brief résumé of the results of my enquiry:—

Madras.—The systematic collection of rainfall data commenced in 1868 under Mr. Pogson, Government Astronomer. The whole of the data from 1868 to 1885 are bound in large volumes, which are the property of the Board of Revenue. The work of superintending the collection of the Madras rainfall data was transferred to Miss Pogson, Meteorological Reporter for Madras, in January 1886, and the data of the period 1886 to

1889 are with her, but have not as yet been bound in volumes. Mr. Pogson has recently gone through the whole of the rainfall data from 1868 to 1885, applied corrections for errors in the diameters of the receivers, &c., and obtained monthly means. These results, which give the most accurate monthly means of rainfall for the Madras revenue stations at present available, have unfortunately not yet been published by Mr. Pogson. There are over 22 years' records of rainfall available for Madras at the present time.

Mysore.—The rainfall returns for about 80 stations from 1870 to November 1886 are available in the office of the Dewan of the Mysore State, and those since that date have been filed in the office of the Director of Statistics and Agriculture, Mysore.

Bombay.—The rainfall data of the Bombay Presidency previous to the year 1879 were, so far as I could ascertain, not available. I was informed that the collection of the rainfall data was originally a part of the duties of the Curator of the Victoria and Albert Museum, Byculla, and of the Sanitary Commissioner. The rainfall data have been, from June 1886, collected by the Director of Agriculture, and are very carefully examined and fully tabulated in the Director's Office. The rainfall data of this period, 1879 to 1889, were obtained from the Director's Office and tabulated by the Bombay Meteorological Office for the Calcutta office.

Berar.—Monthly rainfall totals and means of a considerable number of stations are published in the Sanitary Commissioner's Report. No copies of original data are kept in the Commissioner's Office or Sanitary Commissioner's Office. Original and complete data for a few districts (*viz.*, Akola, Wun, Amraoti, Basim, Buldana, and Ellichpur) have been obtained from the Deputy Commissioners of these districts.

Central Provinces.—The daily rainfall data of all the sub-divisional stations have been published in the Gazette weekly since 1st January 1867. Flemings' float gauges were largely used until a few years ago. There was no systematic examination of the returns for several years after the commencement of rainfall registration, and hence the earlier data are sometimes unreliable. The whole of the rainfall data for the period of 22 years, from 1867 to 1888, has been extracted from the *Central Provinces Gazette* and tabulated.

North-Western Provinces.—Weekly rainfall statements have been published in the *North-Western Provinces Gazette* from the year 1864. The data were originally collected and the tables prepared in the Secretariat Press Office, but this work was transferred to the Meteorological Reporter in the year 1876. During the greater portion of this period of 26 years from the year 1864 to the present time, daily rainfalls were given in the Government Gazette. For some time previous to the 31st July 1877, only weekly totals were given. The records for a portion of this period were available, but those for the period 27th June 1876 to 30th July 1877 were destroyed some time ago, and it is not possible to replace them except by referring to the Collectors' Offices, and it has not yet been ascertained whether they have been preserved there. The whole of the available information has been tabulated, and, in the great majority of cases, extends over 25 years.

Punjab.—Rainfall information was first published in the *Punjab Gazette* in 1862. During that and the three following years, monthly abstracts were published giving the total rainfall at 35 stations. From the 25th February 1866, weekly rainfall returns were published in the Gazette, which gave at first the daily rainfall of 125 stations. The number of stations was gradually increased, and in 1883 the returns of 165 stations were given.

From 1862 to 1883 the returns were compiled in the office of the Financial Commissioner. The work was transferred in the latter year to the Director of Land Records. The returns have for several years been carefully scrutinised, and references made to the District Officers when they appeared to be erroneous. The whole of the rainfall data from 1866 to 1888 have been tabulated in the Calcutta office from the published returns in the *Punjab Gazette*.

Burma.—The Calcutta Meteorological Office has rainfall data of the sudder stations of each district in Lower Burma for the past eleven years. I was unable to ascertain in Rangoon whether any arrangements had ever been made for collecting rainfall data from sub-divisional stations or other stations than the sudder towns, but whatever rainfall data had been collected and stored in the Secretariat were destroyed two or three years ago, when it removed into the buildings it now occupies.

Bengal.—The rainfall data have always been collected by the Meteorological Department and published in the *Calcutta Gazette*. It is hence probable that they are more reliable than for any other provinces. The weekly statements previous to January 1883 gave only the weekly totals, but since that date the daily rainfall has been published. The daily rainfall since January 1870 is fully tabulated for reference in the Calcutta office.

STORM OBSERVATIONS.

25. A circular was prepared giving full instructions to the observers what kinds of observations were desired, and a copy was sent to each observer, together with a supply of special forms, for the record of these observations. Three hundred and two sets of observations were sent in by observers. A large proportion of these were records of thunderstorms, hailstorms, nor-westers and duststorms, or storms of the hot weather, and threw some additional light on the distribution of these storms. A small proportion furnished data of cyclonic storms and cyclones. Some of these furnish an accurate record of these storms and show intelligent and careful observation on the part of the observers. They give very valuable information which will be utilised in the discussion of the storms. Special amounts, varying from Rs 1 to Rs 60 and dependent upon the extent and value of the observations, were granted to observers for these storm data.

MARINE METEOROLOGY.

26. Much greater attention has been paid to this important subject than hitherto. Mr. Little has devoted much time to it, with the result that a much larger number of logs has been obtained for the Bay of Bengal than in previous years. The amount of work, in fact, increased to such an extent that the one clerk told off in the Calcutta office to do the work was latterly unable to do the whole of the work satisfactorily. Advantage was taken of the opportunity afforded by the transfer of Babu Chandi Charan Chatterjee and the abolition of the native meteorological inspectorship as a separate post, to obtain sanction of an additional clerk for this work. These two clerks are now fully occupied in collecting weather information from all vessels that enter the port of Calcutta. They also make a careful comparison of the barometers on board the ships they visit, in order to obtain the correction of these instruments to the Calcutta standard.

27. The Bombay Meteorological Office was asked to take up the work of collecting

information from vessels entering the port of Bombay and to carry it out in the same manner and by the same methods as are adopted at Calcutta. The Head Clerk especially interested himself in the work, and, although the office was much pressed by the labour of preparing the daily weather report and chart, a large amount of information was obtained and forwarded to Simla. In all full extracts were made from the logs of 535 vessels entering the port of Bombay, and a comparison of their barometers (in each case from 4 to 12 readings being taken) with a secondary Calcutta standard was made.

28. The following table gives a statement of the work done under this head during the past year and the corresponding figures of the two previous years for comparison :—

		1889-90.	1888-89.	1887-88.
CALCUTTA	Number of logs extracted	419	338	214
	Number of barometric comparisons	334	*	*
BOMBAY	Number of logs extracted	535	72	94
	Number of barometric comparisons	420	*	*

* No regular or satisfactory comparison of barometers was made previous to the year 1889-90.

29. The extracts are tabulated in a suitable form, and a commencement has been made in preparing weather charts of the whole Indian area for the south-west monsoon period of 1889 (commencing with the 1st of May 1889). It is not intended to publish the charts of the year 1889, as they are of an experimental character with the view of determining the best method of extracting and charting the data, and of ascertaining whether they are sufficient in amount to give a fairly complete view of the weather in the whole Indian Sea and land area, and of the changes from day to day. If, as is hoped, the results are satisfactory from this point of view, a commencement will be made next year in the work of preparing and issuing daily charts of the whole Indian area as proposed in my scheme of changes and described in the last Administration Report, pages 6 and 7.

SEASONAL FORECASTS.

30. The forecast of the probable character of the distribution of rainfall during the south-west monsoon of 1888-89 was made in the same manner as in the preceding year. A preliminary memorandum, or provisional forecast, was prepared by Mr. Dallas during my absence on duty at Bombay, and published in the *Gazette of India* of the 20th of May 1889. The ordinary memorandum, or final forecast, based on all information received up to the end of May, was prepared by myself on my return from tour in Bombay, and issued in the *Gazette of India* of the 13th of June.

31. These forecasts are based partly on information of the snowfall in the mountain districts of Northern India during the previous cold weather months, and partly on the distribution of pressure in the month of May, and the changes in the abnormal features of the pressure distribution that have been effected during the hot weather months of April and May, and the character of the hot weather during these months.

32. The following gives a brief summary of the data on which the forecast of the character of the rainfall during the south-west monsoon of 1889 was based :—

(A) *Snowfall information.*—The following gives a brief summary of the chief features of the snowfall during the winter of 1888-89 in the Afghan and Himalayan mountain area :—

(1st.) The snowfall of the winter of 1888-89 occurred chiefly during the months of December to February. There was no heavy snowfall in any part of the Himalayas during the three months March to May 1889.

(2nd.) In the Afghan highlands the snowfall was not only less in amount than usual, but melted with greater rapidity than usual in consequence of the occurrence of heavy rain almost immediately after the more severe snow-storms of the season.

(3rd.) The distribution of snowfall in the North-West Himalayas was somewhat irregular. Apparently larger amounts than usual fell over the whole of that mountain area. In the lower and middle elevations of the outer ranges the snowfall was followed by heavy rain in February and March, which assisted to melt it, and hence the depth of snow was no greater in the lower passes of Kulu, &c., at the end of May than it was in May 1888. In the higher elevations (above 13,000 or 14,000 feet) the snowfall was unusually heavy and was not followed by rain. The weather was more cloudy and disturbed in March and April than usual. In consequence of this combination of conditions there was an unusual accumulation of snow in the higher passes and elevations of Kulu, Plach, and Lahoul. There was, on the other hand, less snow than usual in Cashmere and Ladakh. The information of the snowfall in the Gurhwal Himalayas was very limited, but so far as can be judged from the accounts it was not excessive.

(4th.) In the Eastern Himalayas the snowfall was, so far as can be judged by the reports of the hill-men, less than during the preceding winter and probably somewhat below the average.

(B) *Meteorological conditions in India antecedent to the south-west monsoon of 1889.*—The most striking features of the period January to May 1889 were the excessive rainfall over the whole of Northern India (more especially in the Punjab, the North-Western Provinces, and Behar) in the month of February, and the abnormally high temperature and excessive dryness of the air which prevailed during the months of April and May over the greater part of the country, and more especially in the North Deccan, the Central Provinces, Central India, the North-Western Provinces, Behar, and Rajputana.

The following were the more important pressure anomalies of the month of May :—

(1) Pressure was, relatively to the general state, in defect over the greater part of the Peninsula and in Burma, Assam, Bengal, Behar, and the northern half of the North-Western Provinces. The deficiency was not large in amount in the Peninsula or Burma, but was excessive in Behar and Central Bengal (where it averaged '04 inch).

- (2) Pressure was relatively in excess in North-Western India including the Punjab, Sind and Rajputana, but the anomalies were small, except in the Punjab, for which they averaged '03 inch.

The following were the conclusions respecting the probable character of the south-west monsoon of 1889 based on these data :—

- (1st.) The weather conditions in May over the land area of India, and the character of the cold weather snowfall, were both favourable to the probable occurrence of an early and strong monsoon.
- (2nd.) Conditions were unusually favourable for heavier rain than usual over the whole of North-Eastern India, including Burma, Assam, Bengal, Behar, and the greater part of the North-Western Provinces. It was difficult to estimate the effect of the local pressure conditions in Behar, as they were much less plainly marked during the second half of the month than during the first half, and were hence, to some extent, temporary in character. The tendency of a persistent low pressure area in Behar during the monsoon is to give increased rainfall over that area and the districts to the east, south and south-west, that is, over Behar, the greater part of Bengal, Chutia Nagpur, and the Central Provinces, and to diminish the rainfall to the west in the North-Western Provinces. Hence there was a strong probability that Behar, Bengal, and the Central Provinces would receive normal to abundant rain, and Burma and the North-Western Provinces normal rainfall.
- (3rd.) The conditions in the Peninsula were on the whole favourable, and hence it was probable that the Bombay monsoon current would be at least of normal strength and give normal rainfall over the Peninsula generally.
- (4th.) The conditions in Upper India, and more especially the Punjab, were more or less unfavourable. The rainfall of the Punjab depends to a somewhat larger extent on the strength of the Bombay current than on that of the Bay of Bengal. The rainfall in the Punjab and Rajputana would, it was stated, hence be probably less than the normal, and the deficiency depended largely on the effect of the Behar low pressure area in diminishing the effect of the Bay of Bengal current in Upper India. If that were a temporary and not a permanent feature of the monsoon, the deficiency would probably not be marked. On the other hand, if it were permanent, and also deflected the Bombay monsoon current more directly across the Peninsula than usual, the deficiency would probably be large and be relatively greatest in the central and western districts of the Province.
- (5th.) So far as could be judged from the observations, it was, on the whole, probable that Ganjam and the Northern Circars would receive at least normal rainfall.

33. The following table, extracted from the Weekly Rainfall Report of the second

week of October 1889, affords a basis of comparison between the forecast and the actual rainfall results of the south-west monsoon of 1889:—

PROVINCE.	DIVISION.	RAINFALL DATA AND COMPARISON WITH THE NORMAL FOR THE PERIOD, MAY 13TH TO OCTOBER 14TH, 1889.		
		Average Actual Rain- fall of period.	Average Normal Rainfall, May 13th to October 14th.	Excess or De- fect of rainfall of period ex- pressed as a percentage.
		Inches.	Inches.	Per cent.
BURMA	Tenasserim	183'85	175'83	+ 5
	Lower Burma	84'85	91'02	— 7
	Central Burma	58'94	72'74	— 19
	Upper Burma	39'33	?	?
	Arakan	167'85	178'00	— 6
BENGAL AND ASSAM	Eastern Bengal	66'68	79'04	— 16
	Assam (Surma)	115'67	93'65	+ 24
	Do. (Brahmaputra)	78'98	67'47	+ 17
	Deltaic Bengal	44'04	50'60	— 13
	Central Bengal	48'60	50'32	— 3
	North Bengal	98'43	92'83	+ 6
	Orissa	45'91	48'96	— 6
	Chutia Nagpur	44'03	46'95	— 6
	Behar (South)	40'72	39'89	+ 2
	Do. (North)	52'85	45'80	+ 15
NORTH-WESTERN PROV- INCES AND OUDH.	North-Western Provinces (East)	43'72	33'91	+ 29
	Oudh (South)	40'43	34'20	+ 18
	Do. (North)	42'21	36'81	+ 15
	North-Western Provinces (Central)	27'02	28'94	— 7
	North-Western Provinces (West)	21'74	25'98	— 16
	North-Western Provinces (Submontane)	48'54	39'87	+ 22
PUNJAB	Punjab (South)	11'62	12'56	— 7
	Do. (Central)	16'75	21'57	— 22
	Do. (Submontane)	20'54	24'92	— 18
	Do. (Hill Districts)	59'29	77'94	— 24
	Do. (North-West)	16'07	18'76	— 14
	Do. (West)	6'72	6'60	+
BOMBAY AND MALA- BAR COAST DISTRICTS (MADRAS).	Malabar	110'38	102'14	+
	Madras (South Central)	36'10	18'91	+ 91
	Coorg	100'86	97'80	+ 3
	Mysore	27'65	22'84	+ 21
	Konkan	125'95	96'04	+ 31
	Bombay Deccan	31'90	29'11	+ 10
	Hyderabad (North)	...	...	...
	Khandesh	21'68	24'52	— 12
CENTRAL PROVINCES AND BERAR.	Berar	34'22	32'73	+ 5
	Central Provinces (West)	35'44	39'25	— 10
	Ditto (Central)	50'79	48'96	+ 4
	Ditto (East)	55'89	48'44	+ 15
BOMBAY (NORTH).	Guzerat	35'58	38'82	— 8
	Kathiawar	27'69	26'61	+ 4
	Sind	1'55	4'39	— 65
RAJPUTANA AND CEN- TRAL INDIA.	Central India (East)	38'33	35'33	+ 10
	Rajputana (East), Central India (West)	28'63	25'71	+ 11
	Rajputana (West)	8'73	13'04	— 33
MADRAS	East Coast (North)	37'97	28'16	+ 35
	Do. (North) (a)	38'75	37'43	+ 4
	Hyderabad (South)	25'04	22'34	+ 12
	Madras (Central)	24'67	19'47	+ 27
	East Coast (Central)	20'69	20'90	— 1
	Ditto (South)	22'93	18'16	+ 26
	Madras (South)	15'07	11'60	+ 13

34. The following gives a summary of the preceding statement :—

PROVINCE.	Actual Rainfall.	Average Rainfall.	Percentage Variation.
Burma	123'87	129'40	—4
Assam and East Bengal	87'11	80'05	+9
Bengal	59'25	60'68	—2
Behar	46'79	42'85	+9
North-Western Provinces and Oudh	37'28	33'29	+12
Punjab	21'83	27'06	—20
Rajputana	18'68	19'38	—4
Central India	38'33	35'33	+8
Central Provinces and Berar	44'09	42'35	+4
Madras	26'16	22'58	+16
Bombay, Deccan, and Hyderabad	31'90	29'11	+10
Bombay Coast Districts	118'17	99'09	+19

A comparison of these statements with the forecast shows a very fair agreement. In fact, the forecast was fully verified, except in the case of the following districts, *viz.*, Burma, Bengal, and the North-Western Provinces. In the former two the rainfall was normal or very slightly in defect, and in the latter it was considerably in excess.

STORM WARNINGS.

35. *Bay of Bengal Storm Signal Service.*—This is carried on by the Meteorological Reporter to the Government of Bengal, who warns the following ports according to the methods fully detailed in pages 22 to 26 of the Administration Report of the year 1888-89 :—

(a) *Burma Ports—*

Moulmein.
Rangoon.
Bassein.
Akyab.

(b) *Bengal Ports—*

Calcutta and River Hooghly.
Chittagong.
Orissa Ports, including Pooree,
False Point, Chandbally, and
Balasore.

(c) *Madras Ports—*

Bimlipatam.
Gopalpur.
Vizagapatam.
Coconada.
Masulipatam.
Madras.
Negapatam.
Tuticorin.

The only change that was made in the system of signals was the addition of a signal, which is designated the cautionary signal and is used to give warning to shipping when passing out of the river of the existence of doubtful or squally weather (such as usually precedes and initiates cyclonic storms), and is hence confined to the approaches to the port of Calcutta and the port. The official notice of its introduction was published in the *Calcutta Gazette* of the 29th June 1889.

36. The following remarks, respecting certain features in the working of the storm-warning service, are taken from Mr. Little's Administration Report :—

"In past years the condition of the lines connecting Diamond Island and False Point with the mainland has been the subject of comment. During the year 1889-90 there was no serious stoppage at either station, but the weather was never very stormy during the monsoon season, so that they were not put to the same test as in other

years. The telephone line between Hookeytollah and the False Point light-house has been thoroughly overhauled and the telephone replaced by Morse instruments, which will soon be in use. Though the Telegraph authorities think it unlikely that the line will, even now, be able to stand the strain of very stormy weather, there is no doubt but that it will now be much more reliable.

"With a view to obtain daily meteorological observations from the pilot-brigs cruising at the Sandheads, Mr. Pedler, with the assistance of Mr. S. R. Elson, devised and issued a special code in 1889 (a brief account of which was given in last year's Administration Report), by means of which the meteorological observations taken in the pilot-brigs can be reported by a single hoist of four flags displayed on passing Saugor Island Light-house and thence telegraphed to the Meteorological Office. These telegrams have been received with fair regularity during the past year. The observations seem to have been taken from different instruments and probably by different persons from time to time, so that the pressures reported were not very reliable, especially as there has sometimes been difficulty in ascertaining to what day the observations belonged. A list given below shows the number of telegrams received each month since the system was started.

June 1889	.	.	.	1	November 1889	.	.	Nil.
July "	.	.	.	17	December "	.	.	13
August "	.	.	.	9	January 1890	.	.	10
September "	.	.	.	17	February "	.	.	15
October "	.	.	.	1	March "	.	.	13

"The following tables give a brief summary of the various cyclonic storms in the Bay of Bengal during the last year, and the action taken by this office to warn the coasts affected by them :—

Table giving a brief Statement of the Storms which affected the Bay of Bengal coasts during the year 1889-90.

No. of Storm.	Period of Depression or Storm.	Character of Storm.	Coast affected.
1	May, 21st and 22nd	Feeble depression off the Pegu coast.	Crossed the Orissa coast.
2	June, 9th to 11th	Small depression off the Ganjam coast.	Crossed the North Orissa coast on the 11th.
3	June, 17th	Feeble depression in the north-east of the Bay.	
4	June, 24th to 27th	Feeble cyclonic storm off the Orissa coast.	Crossed North Orissa coast at about 8 P.M. on 26th.
5	July, 12th to 20th	Small cyclonic storm off the Orissa coast.	Crossed the coast between Balasore and Saugor Island on the morning of the 20th.
6	August, 5th and 6th	Small depression over the head of the Bay.	Orissa coast.
7	August, 15th to 17th	Small depression over the head of the Bay.	Crossed through the Sunderbuns.
8	August, 25th and 26th	Feeble depression off the Orissa coast	Crossed the Orissa coast.
9	September, 16th to 19th	Cyclonic storm formed in the centre of the Bay.	Ganjam coast.
10	September, 25th to 27th	Feeble diffused depression in the north-east of the Bay.	Crossed the Bengal coast and passed through the Sunderbuns.
11	October, 4th to 11th	Shallow depression off Circars coast.	Crossed the Circars coast.
12	October, 13th to 16th	Feeble depression off Coromandel coast.	Crossed the Madras coast.
13	October, 21st to 27th	Shallow depression, formed off the Orissa coast, and moved slowly in a northerly direction.	Crossed the coast east of Saugor Island, passing through the Sunderbuns on the 27th.
14	November, 2nd and 3rd	Small depression in the Gulf of Martaban.	Crossed the Lower Burma coast.

Table giving a brief Statement of the Storms which affected the Bay of Bengal coasts during the year 1889-90—continued.

No. of Storm.	Period of Depression or Storm.	Character of Storm.	Coast affected.
15	November, 13th to 20th .	Cyclonic storm formed in the Mid Bay.	The centre passed inland near Gopalpore on the morning of the 20th. The storm gave heavy gales on the Circars and South Orissa coasts.
16	December, 16th to 18th .	Small depression in the south-west of the Bay.	Crossed the Madras coast to the south of Négapatam on the morning of the 18th.
17	December, 23rd to 26th .	Small depression in the south of the Bay.	Moved in a north-westerly direction, and crossed the coast as a feeble depression near Nellore.

Table showing the action taken by the Calcutta Meteorological Office in warning the Coasts affected by the storms enumerated in the above table.

No. of Storm.	HOISTING OF STORM SIGNALS.			WARNING OF PORTS BY CAUTIONARY TELEGRAMS.	
	Ports ordered to hoist signals.	When hoisted.	When lowered.	Ports warned by cautionary telegram.	Time and date of despatch of cautionary telegrams.
1	.....	.....	.....	Madras and Rangoon Madras Moulmein, Rangoon, Bassein, and Tavoy.	11-15 A.M. of 21st May. 11-15 A.M. of 22nd May; 11 A.M. of 23rd May. 9-25 A.M. and 10 P.M. of 22nd and 11 A.M. of 23rd May.
2	Saugor Island . Mud Point . Diamond Harbour . Budge-Budge . Calcutta, Pooree, False Point, Chandbally, and Balasore.	9th June 10-50 hours . Ditto 10-40 „ . Ditto 10-50 „ . Ditto 10-25 „ . Ordered to hoist at 10 hours of 9th June.	10th June 19 hours . Ditto 18-55 „ . Ditto 19 „ . Ditto 18-20 „ . Ordered to lower at 18 hours of 10th June.	Madras and Rangoon . Gopalpore, Calingapatam, Bimlipatam, Vizagapatam, and Coconada. Madras	10-50 A.M. of 8th June. 10-10 A.M. of 9th June. 10-12 A.M. of 9th June.
3	.....	.....	.....	Chittagong	10-10 of 16th June.
4	Saugor Island . Mud Point . Diamond Harbour . Budge-Budge . Calcutta, Pooree, False Point, Chandbally, and Balasore.	26th June 11-1 hours . Ditto 10-45 „ . Ditto 10-40 „ . Ditto 10-12 „ . Ordered to hoist at 10-30 hours of 26th June.	27th June 10-47 hours . Ditto 10-45 „ . Ditto 10-46 „ . Ditto 10-17 „ . Ordered to lower at 10 hours of 27th June.	Gopalpore, Pooree, False Point, Chandbally, and Balasore. Gopalpore and Calingapatam. Madras	9-40 A.M. of 25th June. 10-23 A.M. of 26th June. 11-10 A.M. of 26th June.
5	Saugor Island . Mud Point . Diamond Harbour . Budge-Budge . Calcutta, Pooree, False Point, Chandbally, and Balasore.	15th July 10-50 hours . Ditto 10-40 „ . Ditto 10-30 „ . Ditto 9-58 „ . Ordered to hoist at 10 hours of 15th July.	21st July 6-10 hours . Ditto 6-14 „ . Ditto 6-15 „ . Ditto 6 „ . Ordered to lower at 5-30 hours of 21st July (except Pooree, which was ordered to lower at 15-25 of 20th July).	Pooree, False Point, and Gopalpore. Madras Calingapatam, Bimlipatam, Coconada, Vizagapatam, and Masulipatam.	9-50 of 12th; 10-35 of 14th; 21-5 of 15th; 10-32 of 18th; 10-37 of 19th, and 11-6 of 20th July. 10-50 of 12th; 10-25 of 13th; 11-18 of 14th; 10-35 of 15th; 10-20 of 16th; 10-37 of 18th; 10-55 of 19th, and 11-12 of 20th July. 10-45 of 14th; 10-15 of 15th; 10-18 of 16th; 10-32 of 18th; 10-37 of 19th, and 11-6 of 20th July.

Table showing the action taken by the Calcutta Meteorological Office in warning the Coasts affected by the storms enumerated in the above table—continued.

No. of Storm.	HOISTING OF STORM SIGNALS.			WARNING OF PORTS BY CAUTIONARY TELEGRAMS.	
	Ports ordered to hoist signals.	When hoisted.	When lowered.	Ports warned by cautionary telegram.	Time and date of despatch of cautionary telegrams.
9	Saugor Island . .	17th September 17 hours.	19th September 5-5 hours.	Gopalpore, Calingapatam, Bimlipatam, Vizagapatam, Madras, and Cocunada.	16 hours of 17th; 10-24 and 15-48 of 18th; 4-20 of 19th September.
	Mud Point . .	17th September 17 hours.	19th September 5-5 hours.		
	Diamond Harbour .	17th September 16-45 hours.	19th September 5-15 hours.		
	Budge-Budge . .	17th September 16-7 hours.	19th September 4-45 hours.		
	Calcutta, Pooree, False Point, Chandbally, and Balasore.	Ordered to hoist at 15-30 hours of 17th September.	Ordered to lower at 4 hours of 19th September.		
11	Pooree, False Point, Chandbally and Balasore.	Ordered to hoist at 10-25 of 7th October.	Ordered to lower at 10-43 of 8th October.	Gopalpore and Madras .	10-37 of 7th and 10-50 of 8th October.
12	.....	.....	.....	Coconada, Masulipatam, and Madras.	16 hours of 15th and 10-30 of 16th October.
13	Saugor Island . .	26th October 10 hours	27th October 10-5 hours.		
	Mud Point . .	Ditto 10 „	27th October 10 hours.		
	Diamond Harbour .	Ditto 9-55 „	27th October 10-5 hours.		
	Budge-Budge . .	Ditto 9-7 „	27th October 10-30 hours.		
	Calcutta . .	Ordered to hoist at 8-50 of 26th October.	Ordered to lower at 9-20 of 27th October.		
14	.....	.....	.....	Bassein, Rangoon, Moumein, and Tavoy.	8-35 of 2nd and 8-20 of 3rd November.
15	Saugor Island . .	19th November 11-5 hours.	20th November 15-45 hours.	Madras, Gopalpore, Bimlipatam, Coconada, Vizagapatam, Masulipatam, Negapatam, Akyab, and Rangoon.	10-20 of 13th; 10-10 of 14th; 10-15 of 15th; 10-40 of 16th; 10-25 of 17th; 10-10 of 18th (except Gopalpore, Akyab, and Rangoon); 11-40 and 18-40 of 19th; 10-40 of 20th November.
	Mud Point . .	19th November 11-30 hours.	20th November 15-55 hours.		
	Diamond Harbour .	19th November 11-12 hours.	20th November 15-45 hours.		
	Budge-Budge . .	19th November 11 hours.	20th November 15-27 hours.		
	Calcutta, Pooree, False Point, Chandbally, and Balasore.	Ordered to hoist at 10-10 of 19th November.	Ordered to lower at 15-30 of 20th November.		
16	.....	.....	.....	Pooree, False Point, Chandbally, and Balasore.	10-35 of 14th; 10-15 of 15th; 10-40 of 16th; 10-25 of 17th; 18-40 of 19th; 10-50 of 20th November.
17	.....	.....	.....	Chittagong . . .	10-26 and 18-40 of 19th; 10-40 of 20th November.
16	.....	.....	.....	Negapatam, Tuticorin, and Madras.	10-20 and 17-30 of 17th; 10-20 of 18th; 11 hours of 19th December.
17	.....	.....	.....	Madras, Vizagapatam, Coconada, Masulipatam, Paumben, Negapatam, and Tuticorin.	(Madras 10-2 of 22nd); 10-57 of 23rd; 9-50 and 15-25 of 24th; 10-30 of 25th, and 10-20 of 26th December.

37. The data show that early and full warning was given in every case. So far as I can judge from my own experience, and ascertain from Port Officers and others interested in the proper performance of these storm-warning duties, the work was most satisfactorily performed by Messrs. Pedler and Little during the last year.

38. *Bombay Storm Signal Service.*—The circumstances under which the working of this portion of the storm signal work was transferred from Bombay to Simla were fully stated in last year's Administration Report, and it is unnecessary to recapitulate them. It was also stated that the system in force, when it was taken over, was defective and unsatisfactory, and that I had submitted proposals for the adoption of a system of signals suggested by Sir Henry Morland, Port Officer of Bombay, as most suitable for the conditions and requirements of the West Coast. The proposals were fully considered by the Port and Commercial authorities in Bombay, and were finally approved by the Government of Bombay, and introduced on and from the 15th of September. The following gives a statement of the arrangements approved by the Local Government and published in the *Bombay Government Gazette*:—

“(1) The ports warned by this system are as follows:—

1. Karachi.	4. Bhavnagar.	7. Alibag.	10. Goa.
2. Porbandar.	5. Damaun.	8. Ratnagiri.	11. Marmagao.
3. Veraval.	6. Bombay.	9. Vengorla.	12. Karwar.
13. Kumta.			

(2) The warning officer is the Meteorological Reporter to the Government of India (or Weather India), Simla, and the officers to whom the warning telegrams are addressed and who arrange for hoisting the storm signals as directed by Weather India, are as follows:—

PORT.	Officer to whom warning telegrams will be sent.
Karachi	Port Officer.
Porbandar	Vahiwatdar.
Veraval	Ditto
Bhavnagar	State Engineer.
Damaun	Governor of Daman.
Bombay	Port Officer.
Alibag	Huzur Deputy Collector.
Ratnagiri	Sar-karkun in charge of Custom-house.
Vengorla	Ditto ditto.
Goa	Director, Meteorological Observatory, New Goa.
Marmagao	Agent, W. I. P. Railway.
Karwar	Port Officer.
Kumta	Custom Manager.

(3) In order to enable the India Meteorological Reporter to carry out the work of warning the Bombay Coast ports with the utmost expedition, he is permitted to communicate with the Port Officers or other authorities at the following stations by precedence urgent messages (classed as XXS):—

Karachi.	Bombay.	Vengorla.	Karwar.
Bhavnagar.	Alibag.	Goa	Kumta.
Damaun.	Ratnagiri	Marmagao.	

Hence all messages from Simla to the selected officers at the abovenamed ports, directing signals to be hoisted, will be forwarded by telegrams having precedence over all ordinary urgent messages.

(4) The objects of the system of signals are twofold:

- (1st) to warn the shipping at the ports on the West Coast of India, and more especially at Bombay and Karachi, of the probable existence of cyclonic storms in the Arabian Sea which they are likely to encounter if they leave the port for the Red Sea, &c.;
- (2nd) to warn the Port authorities and shipping of the probable or certain approach of a cyclonic storm to the port in question, in order that any precautions *necessary* may be taken.

These objects are, it should be clearly understood, different. The first, for example, might necessitate the hoisting of a signal at Bombay in fine weather, and when there was no reasonable probability of early bad weather at that port, whilst the hoisting of the second set of signals would necessarily imply probable early bad weather at that port.

Signals intimating the existence of cyclonic storms in the Arabian Sea at a considerable distance from the coast are intended mainly for the information of the Captains of vessels about to leave the important ports of Bombay and Karachi. The import of such a signal is, ‘There is a cyclonic storm in the Arabian Sea which you

may encounter if you proceed to sea. Learn as much as you can of its character and track from the Daily Weather Report issued at Bombay and storm telegrams posted at the Port Office before you proceed to sea.' Such a signal is hence not intended to delay vessels, but to give Captains a warning of the existence of a distant cyclonic storm, and place at their disposal information which may enable them to avoid it if they go to sea.

The second set of signals (warning ports of the approach of cyclonic storms) are intended partly for the protection of the ports and partly to prevent small steamers and vessels putting out to sea when they are likely to encounter stormy weather which may overwhelm them, although a large and well-appointed steamer might pass through it without injury.

(5) The system of warning will be carried out by signals hoisted in a prominent position in each port supplemented by telegrams, giving so far as is possible the position, character, line of march, &c., of the storm, which will be posted up in some prominent position in the Port or other Offices for general information. These telegrams will be sent at intervals, usually of 8 or 12 hours and never exceeding 24 hours, during the progress of the storm, and will give as far as possible all important changes in the character of the storm or other important feature in its progress during the interval since the last telegram.

(6) It should also be distinctly understood that the signals will only be hoisted before and during cyclonic storms and will not be employed to indicate the prevalence of strong westerly winds, approaching in force to a gale, which occur occasionally during heavy bursts of the monsoon, and are partly, if not entirely, dependent upon conditions in the interior of India.

(7) The signals employed by day will be made by means of two canvas shapes, a cone and a drum.

The cone is 3 feet high and 3 feet wide at base and appears as a triangle when hoisted. The drum is 3 feet high and 3 feet in diameter and appears as a square when hoisted.

The night signals will be made by lanterns showing a red light. The lanterns should be at least 3 feet apart.

The following is the system of storm signals employed to warn Bombay and the West Coast ports of India :—

Signal No. 1, or warning signal, consists of a canvas shape representing a drum, and when hoisted signifies that a storm is in existence in the Arabian Sea which may either approach the port or which may shortly cross one of the usual tracks of vessels leaving the port.

There is no night signal corresponding to this day signal.

Signal No. 2, a black cone apex down by day, and three red lights apex down by night.

The signal signifies that a cyclonic storm is likely to affect the port, and give it strong winds at first from southwards. The shift of wind will depend on the track of the storm (*i.e.*, whether from east or west, &c.).

Signal No. 3, a black cone apex up by day, and three red lights apex up by night.

This signal signifies that a cyclonic storm is likely to affect the port, and give it strong winds at first from northwards. The shift of wind will depend upon the track of the storm (*i.e.*, whether from east or west, &c.).

Signal No. 4, a black drum over a black cone by day and four red lights in the form of a square by night.

This signal signifies that a heavy cyclone is approaching the port, and that the centre will probably pass over or very near to the port; and hence that the shift of wind is likely to be rapid and the strength of the wind to be very great.

(8) The signals will be hoisted at each port by the officer appointed on receipt of instructions from the Simla Meteorological Office. They will be kept flying until dusk and then be lowered and hoisted again next morning. The signal at a port may be changed (as, for example, from No. 2 to No. 3) during a storm when the indications become more definite and show that the storm is approaching the port. All such changes will be made under instructions from the Simla Meteorological Office; and the signals will be finally lowered on receipt of instructions from the Simla Office when the storm has broken up or is no longer likely to give bad weather at that port.

If the second, third, or fourth day signal is hoisted at any port, it will be replaced at night by the corresponding night signal, so that as soon as the day signal is lowered the corresponding night signal will be hoisted and remain in position until daybreak when the day signal will be again hoisted.

Meaning of Signals.—This has been partly stated above. The ports on the West Coast are liable to two classes of storms, *viz.* :—

(a) Storms which form in the Arabian Sea itself;

(b) Storms which form in the Bay of Bengal, advance across India and pass out into the Arabian Sea.

In the first case the observations sometimes give indications of storms in the Arabian Sea which march westwards. If these are likely to approach the steamer tracks between India and the Red Sea, telegrams will be sent to Aden for the information of steamers, and the first signal be hoisted at the larger ports, *e.g.*, Bombay, Karachi, &c. Again, the second class of storms rarely give strong winds to the ports south of Surat. These are all to a large extent protected by the West Ghâts. When they cross the West Ghâts and pass out to sea, if conditions are favourable, they may increase in intensity and become fierce and dangerous storms. They also occasionally recurve in the Arabian Sea and approach the coasts of Gujarat, Sind or Biluchistan. In such cases the first signal only will usually be hoisted at ports on the coast, such as Karwar, whilst at the ports on the Sind, Cutch

and Kathiawar Coasts the warning signal will be first hoisted and afterwards one or other of the danger signals may be hoisted during the latter existence of such a storm.

Hence the hoisting of the first signal is intended as a sign that there is a cyclonic storm in existence in the centre or north of the Arabian Sea, which is likely to be encountered by steamers leaving the ports of Karachi or Bombay, or that a cyclonic storm is passing across the West Ghâts out into the Arabian Sea, which, although not likely to give strong winds (or a gale) to the ports at which the signal is hoisted, may give a gale at a distance of 50 or 100 miles from the coast. The knowledge of its existence will hence be chiefly useful to Captains of steamers. Its meaning is: 'If you leave port you may run into bad weather. If you wish for more precise information before you leave port, go to the Port Office and see what the weather telegrams posted there say.'

In the case of the second signal a storm which is likely to give a gale is approaching the port. Its import is: 'Take the precautions necessary for riding out the gale as soon as you think it advisable.' The precautions are usually stated in the rules of the port."

39. In consequence of the change of system in the middle of the year, the storm signals were hoisted during the period 1st of April to 15th of September in accordance with the old arrangements, and from the 16th of September to the 31st of March in accordance with the regulations of the new system.

40. The following gives a statement of the storms which affected the West Coast during the year 1888-89:—

No. of Storm.	Period of Depression or Storm.	Character and Track of Storm.	Coast affected.
1	7th May	Shallow depression over Kathiawar and adjacent portion of Arabian Sea. It was of little importance as it filled up in next 24 hours.	Coast of Kathiawar.
2	14th May	A shallow hot weather depression appeared in Sind on the 13th and intensified considerably on the 14th. It filled up on the 15th.	Coast of Sind and Kathiawar to which it gave very strong winds. The velocity of the wind for a few minutes in a duststorm at Karachi on the evening of the 14th was upwards of 60 miles per hour.
3	17th to 19th May . .	Shallow hot weather depression in Sind, which intensified slightly on the 18th and filled up on the afternoon of the 19th.	Coast of Sind to which it gave strong winds.
4	29th May to 9th June . .	Formed in front of the advancing monsoon off the Malabar or Koncan Coast. It apparently first advanced northwards as an irregular depression until it reached the latitude of Bombay where it rapidly intensified, recurved and advanced in a north-west, and then in a west direction across the Arabian Sea to the Arabian Coast, probably near the Kuria Muria Islands.	Gave very stormy weather over the east and north of the Arabian Sea, and affected the west coast of India from Mangalore to Kathiawar. Winds were probably most violent from Karachi to Porbandar or Dwarka.
5	14th to 16th June . .	Deep hot weather depression in Upper Sind, where the barometer was two-tenths of an inch below the normal. It formed rapidly on the afternoon and night of 13th and filled up on the 16th.	Gave very strong winds to the coast of Sind.
6	23rd to 27th June . .	Hot weather depression in North-West Punjab and Upper Sind.	Gave strong winds to the coasts of Sind and Kathiawar.
7	8th and 9th August . .	Shallow depression appeared on 7th to the south of the Sind Coast. It crossed the coast during the day and advanced northwards into Beluchistan and Upper Sind on the 9th, and apparently filled up in Beluchistan on the 10th. It was chiefly remarkable for the heavy burst of rain in that area, which caused serious floods and breached the railways.	Squally weather to the south of the coast of Sind.

No. of Storm.	Period of Depression or Storm.	Character and Track of Storm.	Coast affected.
8	13th to 18th September	Apparently formed near the Laccadives, advanced northwards and lay off the Koncan Coast on the 15th, and the Coast between Ratnagiri and Surat during the next three days and then slowly filled up. It gave very heavy to furious squalls and very disturbed weather in this part of the Arabian Sea.	None.
9	5th to 8th October	Shallow depression formed off the Malabar Coast near Karwar on the evening of the 4th. It advanced on the 5th and 6th very slowly northwards, and on the 7th was between the Bombay Coast and Kathiawar. It was very shallow throughout and filled up during the next 24 hours.	Gave strong winds and squally weather to the coast from Karwar to Bombay.
10	13th to 22nd October	This storm formed in the south of the Bay of Bengal, crossed the Coromandel Coast on the night of the 15th, and marched across the Peninsula to Belgaum, where it was nearly stationary for 24 hours, during which it recurved northwards. It then advanced in a north-east direction into the Central Provinces where it filled up.	Coast between Mangalore and Karwar, to which it gave strongish winds on the 17th, when the depression was stationary near Belgaum.
11	17th to 20th November	Cyclonic storm which formed in the south of the Bay and advanced in a general northerly direction to the coast of Ganjam.	Did not affect the West Coast of India.
12	17th to 19th December	Cyclone which formed in the Bay of Bengal to the north-east of Ceylon. The centre crossed the coast near Negapatam on the 18th. The depression filled up in Southern India.	Affected the Malabar Coast very slightly giving it moderate winds and heavy rain.
13	24th to 29th December	Cyclonic storm which formed to the west of the Andamans and advanced to the North Coromandel Coast, which it crossed on the evening of the 20th. It filled up in the South Deccan and gave rise to a shallow depression in the Arabian Sea off the coast of Konkan.	West Coast from Ratnagiri to Trivandrum, to which it gave squally weather.
14	10th February 1890	Anticyclone in Biluchistan, which gave rise to strong north-east winds and gales in the north of the Arabian Sea, and squally weather in the Persian Gulf.	Coast of Sind.

41. The following gives a statement of the action that was taken to warn the west coast during the cyclonic storms which affected it :—

Storm No.	Date.	Hour of despatch of cautionary telegram or of telegram ordering signal to be hoisted.	PORTS WARNED BY	Signal hoisted number.	Time of taking down signal.
			Cautionary telegram (c). " signal (s).		
1	7th May 1889.	...	Damaun, Bhavnagar, and Bombay (c).		
2	14th " "	...	Karachi (c).		
3	19th " "	...	Karachi (c).		
4	30th " "	...	Bombay (c).		

Storm No.	Date.	Hour of despatch of cautionary telegram or of telegram ordering signal to be hoisted.	PORTS WARNED BY	Signal hoisted number.	Time of taking down signal.
			Cautionary telegram (c). " signal (s).		
	3rd June 1889 .	...	Bombay, Alibagh, and Ratnagiri (c) and (s) .	Drum . . .	Lowered on 8th, except at Ratnagiri where on 7th.
	4th June " .	...	Vengorla, Goa, Marmagao, and Karwar (s) .	Drum . . .	Lowered on 7th.
	5th " " .	...	Damaun and Bhavnagar (s) . . .	Drum . . .	Lowered on 8th.
	6th " " .	...	Karachi (c).		
5	14th " " .	2-57 P.M.	Karachi (c).		
6	23rd " " .	3-49 "	Karachi (c).		
7	8th Aug. " .	3-17 "	Karachi (c).		
8	18th Sept. " .	1-30 "	Bombay, Marmagao, Karwar, and Mangalore (c).		
10	17th Oct. " .	11-40 A.M.	Bombay and Alibagh (s)	Signal No. 1 . .	Lowered on the 19th at 11-41 A.M.
	" " " .	" "	Vengorla, Goa, Marmagao, and Kumta (s) .	Signal No. 3 with apex upward.	Lowered on 19th at 12-56 P.M.
	" " " .	" "	Ratnagiri (s)	Signal No. 3 with apex down.	Lowered on 19th at 11-41 A.M.
	" " " .	" "	Calicut, Mangalore, Cochin, and Alleppy (c).		
	18th " " .	12-56 P.M.	Alibagh and Bombay (s)	Signal No. 3 . .	Lowered on 19th at 11-41 A.M.
11	17th Nov. " .	4-15 "	Mangalore, Calicut, and Cochin (c).		
12	18th Dec. " .	4-12 "	Calicut, Cochin, and Alleppy (c).		
13	27th " " .	3-42 "	Bombay, Karwar, Alibagh, Ratnagiri, Vengorla, Goa, and Marmagao (c).		
	29th " " .	"	Karachi, Veraval, and Porbandar (c).		
14	10th Feb. 1890 .	3-50 P.M.	Karachi (c).		

42. A comparison of these two tables appears to establish that ample warning was given to the west coast ports affected by the storms of the past year. The only warning probably to which objection might be taken was that of Bombay on the 17th and 18th of October during the period when a cyclone, which had advanced from the Bay to the foot of the West Ghâts near Belgaum, remained nearly stationary for upwards of 24 hours, and then recurved to north-east, instead of passing over the West Ghâts into the Arabian Sea. It will probably be found advisable either to have a special signal for these storms, which can be used so long as it is doubtful whether they will cross the Ghâts and give squally or stormy weather in the adjacent part of the Arabian Sea, or to warn the ports and shipping of the approach of these storms to the West Ghâts by the use of cautionary telegrams only. The system of signals is, however, as yet only imperfectly understood, and it is doubtful whether it would be advisable to make any changes until we have had at least two or three years' experience of their working.

43. In connection with the working of the west coast storm-warning service, it may be noted that advantage was taken of certain office changes in the Simla Secretariat Buildings to remove the Meteorological Office to "Constantia," near to the Telegraph Office, and to make arrangements for Mr. Dallas, who prepares the daily reports,

and issues the storm warnings, to live in the lower flat beneath the office. This arrangement has effected a considerable improvement in the working of the storm-warning service for the west coast, and enables storm information to be obtained and warnings to be issued at any hour of the day or night without delay.

44. I have received unofficially during the past year the following suggestions for improvements in the storm-warning work—

- (a) that it would be desirable to warn the inland port of Naraingunj in Bengal;
- (b) that it would be advisable to state more definitely the directions of storm tracks;
- (c) that in the River Hooghly, the signals might be lowered, and the movements of vessels left to the discretion of the officers in charge after the wind has hauled to the southward or westward, according to the path of the centre of the storm.

45. The Meteorological Reporter to the Government of Bengal has been asked to communicate with the Local Government on the subject of the first suggestion. The last is a very practical and useful suggestion, and has been adopted by the Bengal Reporter. With respect to the second, the Meteorological Department endeavours to indicate, as fully as the information it receives enables it to do so, the probable tracks of storms. It would probably do more harm than good, if it expressed opinions without sufficient evidence. According to the instructions at present in force the warning officers state the probable tracks of storms in the warning telegrams, &c., to Port Officers, as soon as the information received in each case enables it to be determined with approximate certainty.

TELEGRAPHIC COMMUNICATION WITH PORT BLAIR.

46. Suggestions have been made at various times for laying a cable between Burma and Port Blair, in order to enable the meteorological observations taken at that station to be utilised in connection with the warning of the port of Calcutta and the Bengal Coast. These suggestions were frequently based on the assumption that the great majority of the cyclones originate near the Andamans, and hence that the observations at Port Blair would afford much earlier information of the existence of these cyclones, and thus enable the warning signals to be hoisted earlier, and more certain information of the character of such storms to be given to the public than is at present possible from the information supplied by the coast observatories.

47. I have, however, shown conclusively in the "Hand Book of Cyclonic Storms in the Bay of Bengal" that storms may form in any part of the Bay, except the extreme south, and that by far the largest proportion originate near the Head of the Bay and not near the Andamans. On the other hand, it is also pointed out in the same work that the largest and most intense cyclones which have occurred in the Bay have originated in the centre of the Bay near the Andamans. They, however, increase in intensity as they advance towards the north or west coast of the Bay, and are usually most severe when approaching land. It is hence doubtful whether, if Port Blair were telegraphically connected with the mainland, its observations would give much earlier and more certain information of storms advancing to the north-west angle of the Bay than the present battery of telegraphic reporting stations afford.

48. The extension of the storm signal work to the coasts of Burma and Madras (more especially the former) has, however, greatly increased the necessity for the extension. The Department is now ordered to warn the ports of Bassein, Moulmein, and Rangoon. The great majority of the storms which affect these ports form in the Andaman Sea a comparatively small sea area when compared with the Bay of Bengal. They hence advance from their birth place to land in a much shorter time usually than that taken by storms in the Bay of Bengal. Excepting Tavoy, which is situated in a narrow valley and cut off from the direct sea winds by a line of hills, nearly 1,000 feet high, all the telegraphic reporting stations for these storms, *viz.*, Diamond Island, Bassein, Rangoon, and Moulmein, are situated in the northern quadrant. It is, however, well known that the indications of storms are strongest to the east and south, and are on the whole feeblest to the north of the central depression. Hence the present reporting stations for these storms are situated in the most disadvantageous position. It is consequently possible under present conditions that a storm might form rapidly in the Andaman Sea and pass northwards over Rangoon, and in such a manner that the present observatories would not give information in time to enable its course and track to be divined, and warning to be given to the Burma ports. Telegraphic information from Port Blair would give the additional information required to work the Burma storm signal service efficiently, and remove the defect which at present renders it possible that the Bengal Reporter might, under exceptional circumstances, fail to warn the Burma Coast satisfactorily.

49. I visited Port Blair last cold weather in order to ascertain by personal inspection the value of the observatory for the purpose of storm indication. The Port Blair observatory is admirably exposed on highish ground, and the undulating ground to the north and east is not high enough to affect the winds. The observer, Mr. Carroll, is a most intelligent officer and takes very great interest in the meteorological observations. He has been many years in Port Blair and informed me that, according to his experience, the observations of the barometer, wind, and sky at Port Blair always give very clear and marked indications of the commencement of bad weather in the centre of the Bay. I subsequently went carefully through the Port Blair observations of previous years to ascertain of what value they would have been if they had been telegraphed regularly to the Bengal Reporter. So far as I can reasonably judge, they would have rarely given earlier information of the commencement of disturbed weather in the Bay than was shown by the present battery of stations round the Bay. They would, however, in the majority of cases, have given early definite information of whether the storm in process of formation was a feeble or powerful one, or of small or large extent. They would also have enabled the probable path to be determined with greater certainty than the present arrangements permitted. Telegraphic communication to Port Blair would hence tend to make the work of storm warning more exact and reliable, and enable this Department to state, with greater certainty than at present, the probable path and intensity of storms approaching the Bengal or Madras Coast. They would also, as already pointed out, give certain and strong indications of the formation of storms in the Andaman Sea, and enable the Department to warn the Burma Coast more certainly and efficiently than at present.

50. Under these circumstances, I considered it advisable to submit without further delay definite proposals for the extension of telegraphic communication to Port Blair in the hope that with the increasing financial prosperity due to improvement in exchange,

and that perhaps the cable might be required for other purposes besides that for which I advocated it, the Government of India might be able to consider it favourably. After due consideration, the Government of India came to the conclusion that telegraphic communication with the Andamans was not urgently required at present for any other object than for meteorological purposes, and consequently it would not feel justified in sanctioning the large expenditure involved.

51. As it is possible that circumstances may arise during the next few years which may make it desirable to lay down a cable to the Andamans, I think it desirable to take the present opportunity to record my opinion, founded on a careful consideration of the whole question, that I consider it desirable, if not absolutely necessary, for the warning of the Bengal and Madras Coasts, that the cable in question should be laid, but that I believe it to be almost essential to the proper and complete protection of the Burma Coast.

SPECIAL DAILY WEATHER TELEGRAMS FOR CERTAIN PORTS IN MADRAS AND BURMA.

52. Some months ago the Port Officer at Madras pointed out that that important port and town was very inadequately supplied with meteorological information. The Bay of Bengal weather reports and charts sent daily by post from Calcutta were received too late to be of any value, and the Simla daily weather telegram was far too brief and general to be of value to Madras, and did not give the information required. He suggested that a daily report, based on a sufficient number of weather telegrams, should be prepared and issued daily by the Madras Meteorological Office. In reply I pointed out that the total cost of the telegrams, extra clerks, &c., would be considerable, and asked whether the Port and other authorities were willing to contribute towards the cost. A similar application was sent about the same time by the Collector of Vizagapatam, suggesting the publication of a weather report at that station for the use of the mercantile community. When it is remembered that the Coast of the Circars and the Coromandel Coast have no shelter for shipping and are more liable to fiercer and more dangerous cyclones than any other part of the coast of India, and have probably suffered even more than the coasts of Bengal and Orissa from storm waves, the desire to have reliable information of the current weather in the Bay is natural and reasonable. As the existing arrangements did not provide this, I visited Madras in December, and consulted with the Port Officer, the President of the Chamber of Commerce, and the Madras Meteorological Reporter, as to the best practical method of giving the Madras mercantile community the information desired. I ascertained that there was no chance of sufficient local funds being raised to maintain a daily report and chart, and learnt that what was really wished, was a telegram daily as early in the day as possible, giving a brief statement of the weather in the Bay that morning. I suggested that it would be possible to arrange for the Bengal Reporter to send an urgent telegram from Calcutta at a daily cost of Rs. 2, which would give all the information that the Port Officer and President of the Chamber of Commerce stated was desired. The arrangement I suggested was that a code should be prepared in such a manner that a single word should give information on five points, *viz.*, pressure, state of the sea, wind strength, wind direction, and condition of the weather, and that an urgent message of eight words selected from the

code should be sent daily, each word referring to one part of the coast, the whole coast from Tavoy to Tuticorin being divided into eight parts.

53. The following extract from the code itself will show fully the extent of information telegraphed daily :—

“Each telegram during ordinary weather will consist of eight words, to be sent by urgent message by this code about 10-30 A.M. daily. When stormy weather occurs, the code messages will be replaced by detailed messages in ordinary language as to the formation and progress of storm.

The following information dealing with five meteorological conditions will be telegraphed every day :—

- (1) Condition as to barometric pressure arranged in five degrees of change—
 - (a) Pressure steady, *i.e.*, when the changes are less than 0.02 inch over the area dealt with.
 - (b) Pressure rising slowly, *i.e.*, when the general increase of pressure is from about 0.02 inch to 0.05 inch.
 - (c) Pressure rising rapidly, *i.e.*, when the general increase of pressure exceeds 0.05 inch.
 - (d) Pressure falling slowly (from 0.02 inch to 0.05 inch).
 - (e) Pressure falling rapidly (above 0.05 inch).
- (2) The state of the sea will be arranged under four heads—
 - (a) Smooth.
 - (b) Slight.
 - (c) Rough.
 - (d) Very rough.
- (3) The wind velocity will be given under four heads—
 - (a) Force light, velocity 0 to 5 miles an hour.
 - (b) Force moderate, velocity 5 to 10 miles an hour.
 - (c) Force strong, velocity 10 to 20 miles an hour.
 - (d) Force very strong, velocity above 20 miles an hour.
- (4) The nature or direction of the wind will be arranged under the headings calm, variable, and the eight compass points (*i.e.*, 10 headings in all).
- (5) The nature of the weather will be given under five headings—
 - (a) Ordinary weather for the season of the year over the whole Bay.
 - (b) Suspicious and unsettled weather which may perhaps develop into stormy weather in that part of the Bay included between 88° and 98° E. Long., and Lat. 10° and 17° N.
 - (c) Suspicious and unsettled weather, &c., in the Bay to the north of Lat. 17° N.
 - (d) Suspicious, &c., weather between 80° and 88° E. Long., and between 10° and 17° N. Lat., and
 - (e) Suspicious, &c., weather to the south of Lat. 10° N.

Each code word telegraphed would give information as to the five above points, *i.e.*, barometer, state of sea, wind strength, wind direction, and condition of weather.

Eight words will be telegraphed always in the same order—

Word No. 1	will represent the conditions along the coast line from Tavoy to Diamond Island.			
" " 2	ditto	ditto	ditto	Diamond Island to Akyab;
" " 3	ditto	ditto	ditto	Akyab to Saugor Island;
" " 4	ditto	ditto	ditto	Saugor Island to Gopalpur;
" " 5	ditto	ditto	ditto	Gopalpur to Coconada;
" " 6	ditto	ditto	ditto	Coconada to Madras;
" " 7	ditto	ditto	ditto	Madras to Negapatam; and
" " 8	ditto	ditto	ditto	for the coast line of Ceylon; but in this case the

information given will be for the day previous, as the Ceylon daily telegrams are not received till about 2 P.M., and, therefore, too late to be utilised for these telegrams.

In the event of the information from any one or more of these sections of the coast not being sufficient to enable a code word to be telegraphed, then the word “Wales” will be telegraphed in the place of the code word.

The following is an example of such a Code telegram—

To Port Officer, Madras.

Absurd, Accrue, Abraham, Acolyte, Wales, Addibility, Adhibit, Abroad.

And this translated would be—

Coast line from—

1. Tavoy to Diamond Island	. . .	Barometer falling slowly; wind S., force 0—5 miles.	Sea smooth; ordinary weather in the Bay.
2. Diamond Island to Akyab	. . .	Barometer falling rapidly; wind N.-W., force 0—5 miles.	Sea smooth; ordinary weather.
3. Akyab to Saugor Island	. . .	Barometer steady; wind N.-E., force 0—5 miles.	Sea smooth; ordinary weather.
4. Saugor Island to Gopalpur	. . .	Barometer falling rapidly; wind N., force 0—5 miles.	Sea slight; ordinary weather.
5. Gopalpur to Coconada	. . .	Observations incomplete; no information.	
6. Coconada to Madras	. . .	Barometer falling rapidly; wind S.-W., force 0—5 miles.	Sea slight; ordinary weather.
7. Madras to Negapatam	. . .	Barometer falling rapidly; wind N.-W., force 0—5 miles.	Sea slight; ordinary weather.
8. Ceylon for day previous	. . .	Barometer falling slowly; wind N.-E., force 0—5 miles.	Sea smooth; ordinary weather.

54. As soon as the Government of India on my application sanctioned the cost of these telegrams, I gave Mr. Pedler an outline of the code which would be required. He worked it out admirably and prepared an excellent code for the purpose.

55. The first telegram to Madras was sent off on the 4th April 1890.

56. These telegrams were found to be so useful that the Madras Government asked that the ports of Coconada, Negapatam, Cochin, and Mangalore might also be supplied with them. The Port authorities at Rangoon, when they learnt that these telegrams were to be sent to Madras, at once recognised that they gave information which would be of much value to the shipping of the port of Rangoon, and asked the Local Government to arrange for a copy of the telegram being daily sent to that port. These additional telegrams were also conditionally sanctioned by the Government of India. Hence this special daily telegram giving a résumé of the weather in the Bay is sent off daily about 10-15 A.M. (Madras time) to the following officers and is utilised for the information of the local authorities and the shipping at the ports where they are received—

Presidency Port Officer, Madras.	Port Officer, Cochin.
Port Officer, Coconada.	Port Officer, Mangalore.
Port Officer, Negapatam.	Port Officer, Rangoon.
Vice-Chairman to the Port Commissioners, Rangoon.	

FLOOD WARNINGS.

57. A considerable extension of work in this direction has been made during the past twelve months.

58. The question of giving warning of floods in the Rivers Nerbudda, Tapti, Mahi, and Sabarmuttee was suggested to the Government of Bombay in 1884 by Mr. Pearson, who was then acting as Meteorological Reporter for Western India. The matter was referred to Mr. Blanford for consideration, and he stated that it would be very desirable, and could be easily done in the case of the Nerbudda and Tapti. He suggested that the

best plan would be to arrange that the observers at the observatories in the upper and middle portions of the catchment area of these two rivers should telegraph to certain officers in the districts situated in the lower portion of these river basins the occurrence of heavy rainfall (*i.e.*, all amounts exceeding 3 inches in 24 hours). The receipt of a number of such reports simultaneously from the different observatories would indicate the extent and amount of the heavy rainfall, and enable these authorities to judge of the probable intensity of the approaching flood due to this burst of rainfall. Such a system of giving information, Mr. Blanford considered, would be more expeditious than for either the Bombay or Simla office to collect the information and telegraph it to the officers to be warned. Mr. Blanford also suggested that the Simla Meteorological Office could give a premonitory notice of the advance of any storm across Orissa and the eastern districts of the Central Provinces, and of its probable further advance westwards, and of the probable occurrence of heavy rainfall likely to occasion floods in the Rivers Nerbudda and Tapti. He also pointed out that it was not at present generally possible to give warnings of floods in the Mahi and Sabarmuttee, as there were no observatories in the upper portions of the basins of these rivers.

59. Mr. Blanford's suggestions were approved by the Government of Bombay, and he was asked to arrange to give warnings to the following officers:—

Collector of Ahmedabad.	Collector of Kaira,
„ Surat.	„ Panch Mehals.
„ Broach.	„ Khandeish,
Political Agent, Rewah Kantha.	
„ Mahi Kantha.	
Agent to Governor General, Baroda.	
Consulting Engineer of Railways to Government of Bombay.	
Agent, Bombay, Baroda and Central India Railway, Bombay.	
„ Great Indian Peninsula Railway, Bombay.	

60. Mr. Blanford accordingly directed the officer preparing the daily report to send telegrams to the abovenamed officers of the passage of cyclonic storms westwards across the Central Provinces and Central India, and of the probable occurrence of heavy cyclonic rainfall in these areas, and of floods in the Rivers Nerbudda or Tapti; and also instructed the observers at the following observatories to telegraph by urgent messages the actual occurrence of heavy rainfall (*i.e.*, all amounts exceeding 3 inches in 24 hours) to certain officers:—

Jubbulpore, Hoshangabad, Pachmarhi, Khandwa, and Chikalda.—To telegraph to the Collectors of Khandeish, Surat, Broach; Agent to the Governor General, Baroda; Consulting Engineer for Railways, Bombay; Agent, Bombay Baroda and Central India Railway, Bombay; and Agent, Great Indian Peninsula Railway, Bombay.

Amraoti.—To telegraph to the Collectors of Khandeish, Surat and Broach, and Agent to the Governor General, Baroda.

61. No arrangements were, however, made for the observers to report to the Meteorological Reporter the performance of their part of the work.

62. As the performance of this duty appeared to me to be of considerable importance, I enquired in September 1888 of the observers concerned what they had done, and ascer-

tained that the observers at Jubbulpore, Hoshangabad, Amraoti and Chikalda had apparently carried out the work satisfactorily, and in accordance with the instructions given to them. The Pachmarhi observer had done nothing, and the Khandwa observer had transferred the duty to some one else without giving any information to the Meteorological Office.

63. On a consideration of the matter, it appeared that, although this plan of warning had several advantages, it was very defective in the following respects :—

(1st) The communication of the actual occurrence of rainfall, and therefore of the strong probability or certainty of a flood, depended upon the isolated action of a number of irresponsible and poorly-paid observers, who, moreover, had no interest in the work, as they received no extra pay for its performance.

(2nd) The absence of any supervision or control to secure the proper performance of the work. There were no arrangements in force for some central controlling authority seeing that at the time of heavy rainfall in the areas in question the work was carried out properly and the telegrams despatched without delay.

(3rd) Finally it appeared doubtful whether the receipt of a number of isolated telegrams was the best mode of conveying the information of heavy rainfall and of suggesting the probability of heavy floods to the officers concerned.

64. I therefore wrote to the officers to whom warnings were sent, and asked their opinion as to whether sufficient intimation of floods had been received and been of use, and asked their opinion as to whether they considered the present system satisfactory, or whether it would not be better for the Simla office to assume the responsibility of collecting the information and of warning the officers so far as it considered desirable or necessary.

65. The majority of the officers addressed, including the Agent to the Governor General at Baroda, the Collector of Broach, the Agent of the Great Indian Peninsula Railway, the Collector of Surat, the Agent of the Bombay, Baroda and Central India Railway, considered the present system satisfactory, and that it would be undesirable to make any change, and more especially to concentrate the work at Simla.

66. The Executive Engineer at Surat suggested that the depths of the rivers at Akola, Bhusaval, and Barhampur should be gauged and reported.

67. The Collector of Khandeish wrote as follows :—

“I duly receive storm warnings from certain observatories in the Nerbudda and Tapti basins, but these are not of much value in a district like Khandeish, though I can understand their being very useful in a place like Surat. The Nerbudda only touches a small portion of the north-western frontier of Khandeish, and the country there is almost entirely thick jungle, so that floods in that river do not affect Khandeish. The case of the Tapti is different, but I have no means of communicating with eight out of the eleven talukas bordering on that river except by post. The mamlatdars of the talukas would then have to send notice to the villagers, and by the time the notice reached them, the floods would probably be over.”

68. I fully endorse the Collector's remarks on the almost insuperable difficulty of transmitting flood warnings to the agricultural population of India. There is no difficulty in giving warning to officers in charge of important engineering works, canals, &c., who are within easy reach of the telegraph; and in such cases the warnings given

are almost certain to be properly estimated and accepted as indicating probabilities and contingencies against which it is desirable to provide, but not as necessarily stating certainties. On the other hand, it is only too probable that warnings injudiciously distributed amongst the agricultural population of India (more or less untrained in such matters) would occasionally produce something like a scare, and if the results were not commensurate with their expectations, based on the erroneous interpretation of what might be a useful warning, it would cause them to be disregarded in future. The following remarks of the Collector of Ahmedabad illustrate this difficulty :—

“I have had too little experience of the present system to give a decided opinion, but I am certain it will be very useful if flood warnings can be given from your office. Last year we had a very poor rainfall here and the only telegrams I got were unfortunate.

“A cyclone which left the Bay of Bengal was reported to be coming this way and great expectations were raised in consequence.

“The Hindoo traders actually closed their shops, the report being exaggerated into the coming of a general cataclysm. Unfortunately the cyclone, when it got as far as Berar, turned north and deluged Delhi and Cawnpore, so we were disappointed.

“But the great Sabarmatti flood of 1875, which did enormous damage, shows that if you can give us early information of a coming flood in that river, it will enable us to take precautions which may save a good deal of property, perhaps life, as we could close the openings in the city walls on the river side through which the flood finds entrance.”

69. The storm in question, it may be remembered, passed almost westwards from the Bay of Bengal across the Orissa coast into the Central Provinces. Instead, however, of continuing to advance westwards, it recurved to north and gave a deluge of rain in the South-East Punjab and adjacent districts of the North-Western Provinces. Telegrams prepared in accordance with the instructions drawn up by Mr. Blanford were sent when the storm entered the Central Provinces, informing the Collectors of Surat, Ahmedabad and certain other officials of its existence, and of its probably continuing to march westwards and to give heavy rain and floods in the valleys of the Nerbudda and Tapti.

70. In view of the opinions stated above, I have considered it inadvisable to propose any large change in these flood warnings, but have made one or two minor changes, in order that I may be enabled to exercise due control for the proper performance of the work. The following are the arrangements at present in force :—

(1st) The Simla office warns such of the officers named in the preceding list as it considers desirable, of the westward advance of all cyclonic storms through the Central Provinces and Central India, likely to give heavy rain and floods in the valleys of the Nerbudda and Tapti.

(2nd) The observers at the six stations named below have been again requested to telegraph by urgent telegram the occurrence of heavy rainfall at their observatories to certain officers—

Jubbulpore.	Khandwa.
Hoshangabad.	Chikalda.
Pachmarhi.	Amraoti.

(3rd) These observers have also been instructed to inform the Simla office by deferred telegram when they despatch rainfall telegrams.

71. In addition to the above officers, at the commencement of the year 1889-90, the

following officers were informed of the probable or actual occurrence of heavy rain and of floods at their own request :—

Rajahmundry.—Executive Engineer, Godavari, Eastern Division.

Jagadhari.—Executive Engineer, West Jumna Canal, Karnal Division.

Saharanpur.—Executive Engineer, Eastern Jumna Canal, Karnal Division.

Saharanpur.—Executive Engineer, North-Western Railway.

Mooltan.—Engineer-in-Chief, Chenab Bridge Works.

Amritsar.—Superintending Engineer, Bari Doab Circle.

Pishin.—Executive Engineer, Irrigation Division, Military Works.

Damuda District.—District Engineer, Bengal-Nagpur Railway.

Ludhiana and Patiala.—Executive Engineers, Sirhind Canal.

72. Heavy floods in the Lower Indus valley in the first and second weeks of July which breached the North-Western Railway in some places and suspended traffic between Lahore and Karachi for some days, and also breached the bunds on the right-hand bank of the River Indus near Dera Ghazi Khan, directed the attention of the Public Works Department to the subject of floods and flood warnings.

The flood in question occurred before the south-west monsoon rains had set in over the Punjab. The rainfall over the whole of the Punjab (including the hill districts) was too small in amount to account for the heavy floods in the Indus valley. I have not been able to obtain an account of rainfall anywhere in Beluchistan, or the Punjab, sufficient to explain the occurrence of this heavy flood.

73. Heavy floods also occurred in August in the Quetta district and in the hills of Eastern Beluchistan. The Quetta Railway was breached in several places and traffic suspended for some days. Heavy rain undoubtedly fell over a large part of Beluchistan from the 8th to 10th August. It was apparently due to a feeble cyclonic depression and storm which passed from the north of the Arabian Sea into Beluchistan; but so far as can be judged from the rainfall reports received from Quetta, Pishin and Kelat (the only stations at that time reporting rainfall in Beluchistan), the rain, although very abnormal, was by no means excessive. The total rainfall at Quetta during the three days was only 2·22 inches. In connection with this subject, I pointed out that the Meteorological Department received very little information of the rainfall or weather in Beluchistan, and suggested that arrangements might be made for the measurement of rainfall at all stations on the railway from Jacobabad to the Khojak by station masters. The Public Works Department approved of this suggestion, and asked that rain gauges might be supplied to all stations on the North-Western Railway, both on the Bolan and Hurnai routes. This was done in January 1890, and since that date records of rainfall have been regularly kept and sent in to the Meteorological Office.

74. These floods brought under discussion the general subject of flood warnings to officers in the Public Works Department, and the following circular was issued by the Public Works Department on the 9th July 1889:—

“I am directed to request that you will inform officers of the Public Works Department, who may be employed at any time under your orders on important works situated on, or connected with, important waterways or drainage areas, that should they desire to receive warnings of any unusual rainfall which is likely to cause extraordinary floods, and thereby cause damage or delay the progress of the works under them, they must inform the Meteorological Department of the Government of India at Simla that they wish for such warnings, and supply that

Department with full information as to the area on which, during any particular season of the year, exceptional rainfall would affect their works.

"The officer in charge of such a work should apply direct to the Meteorological Reporter to the Government of India, Simla, and should send with his application a sketch map showing the catchment area the rainfall over which would seriously affect the work, and state the period of time during which he would wish to have warnings sent him."

75. The result of this circular was a number of applications for information of heavy rainfall and warnings of floods from Public Works officers, chiefly in Upper India. The following gives a list of the officers to whom such warnings are now sent :—

- Pishin*.—Executive Engineer, Military Works, Irrigation Division.—Heavy rain at Quetta or Jacobabad (only during monsoon).
- Chenab Bridge*.—Engineer-in-Chief, Mooltan.—Abnormally heavy rain at Murree and Sialkot.
- Amritsar*.—Superintending Engineer, Bari Doab Canal (winter).—Heavy rainfall between Bias and Ravi rivers ; also *probability* of heavy rain at the stations Lahore, Amritsar, and Gurdaspur.
- Saharanpur*.—Executive Engineer, North-Western Railway.—Heavy rain exceeding 3 inches at Mussooree, Simla, and Ranikhet.
- Saharanpur*.—Executive Engineer, Warora Division, Lower Ganges Canal.—Any unusual rainfall at Roorkee.
- Saharanpur-Jumna Canal*.—Executive Engineer, Eastern Jumna Canal Division.—Heavy rainfall between Hindun and Jumna and also on the Siwalik range.
- Damoda*.—District Engineer, Bengal-Nagpur Railway.—Heavy rainfall at Hazaribagh or Ranchi.
- Dowlaishevaram*.—Executive Engineer, Eastern Division, Godavery.—Warnings of high floods in the Godavery and of storms likely to cross the coast north of Masulipatam.
- Acquapada-Jajepur Division, Orissa Circle*.—Executive Engineer.—Warnings of any unusual rainfall over the area shaded in the sketch map furnished between the period June to October.
- Rupar*.—Sub-Divisional Officer, First Division, Rupar.—Any unusual rainfall in the valley of the Sutlej, north of Siwaliks.
- Dadupur via Jagadhari*.—Executive Engineer, Western Jumna Canal, Karnal Division.—Any unusual rainfall at Mussooree and Delhi (in the valley of the Jumna, north of Siwaliks).
- Ludhiana*.—Executive Engineer, Ludhiana Division, Sirhind Canal.—Any unusual rainfall over the tract bounded by the Siwaliks, the Sutlej, and Ghaggar rivers and the North-Western Railway.
- Patiala*.—Executive Engineer, Patiala Division, Sirhind Canal.—Any unusual rainfall over the tract bounded by the Siwaliks, the Sutlej and Ghaggar rivers and the North-Western Railway.
- Vellore (North Arcot)*.—Executive Engineer, No. 7 District, South Indian Railway.—Heavy rainfall causing high floods likely to damage the bridgework on the River Palar.

76. There is one point in connection with the flood warnings to which it appears to be desirable to call attention, now that they form a regular and recognised part of the work of the Simla office. This is that the meteorological office is at present working to some extent in the dark, in the absence of any data and information respecting the relation between rainfall and floods in the various larger river basins or catchment areas in India. All that the Department can do at present is to give information of probable or actual heavy rainfall to the officers to be warned, the amount (usually 3 inches or upwards in 24 hours) having been fixed in each case empirically from the general knowledge of the conditions of the district as likely to give rise to serious floods. If this work is ever to be placed on a satisfactory basis, it can only be done by a systematic comparison between actual rainfall and flood data ; and so far as I can ascertain, the latter are not yet available. Gauges should be maintained at a number of stations on each of the larger rivers in India, and the depths recorded on some common plan, and the whole information be systematically collected and fully examined and compared with the rainfall data by some competent officer.

The depth of water in the Punjab rivers is, I am informed, recorded at thirteen places by suitable gauges. There are gauges at several stations (Benares, &c.) on the Ganges, the results of which are published. But with the exception of one investigation, I am not aware of a single effort to work out the relations between the rainfall of a river basin and the resultant floods. The only Department which could record these river depth and flood observations properly and with practically no increased cost to the State is the Public Works Department; and as it is most interested in any results which may be obtained by means of these observations and their comparison with the rainfall data which are now available for every part of India, I think it might be fairly expected to take them up in a systematic manner. The Meteorological Department, in order that it may accumulate some information that may be a guide to it, has asked the Public Works Department that Executive Engineers, who receive warnings of heavy rainfall and of probable floods, should report the actual result of the rainfall in question on the depth of the water and in producing floods.

77. The Department is also now occasionally asked to give information of the probable weather, rainfall, &c., for some time beforehand. All such information is given as fully as possible. The following extract from a letter of the Superintending Engineer of the Bari Doab Circle shows that such information is sometimes of considerable value:—

“The warnings you sent to me last year were of the greatest value, as they enabled me to arrange for the timely closure of the canal.

“I would explain that it is very important that the canal should be closed for repairs for from four to six weeks at some time or other between the 31st December and the 10th March, these dates representing the extreme possible limits within which a closure is possible.

“But in the absence of rain it is not possible (especially in a dry year like the present one, 1890) to close the canal at all, unless there is a fair general fall of rain.

“If we wait till the rain actually falls, many valuable days are lost in making arrangements for the closure, but if, as last year for instance, we can get warning two or three days beforehand, that general rainfall is imminent, we can arrange to collect labour, &c., and close the canal directly rain falls, thus saving several precious days.

“I would, therefore, beg the favour of your again sending me this year timely warnings of any probable general rainfall in the Bari Doab between now and (say) the 15th February next.”

WEATHER REPORTS AND CHARTS.

78. The following weather reports were published during the year by the India Meteorological Office, giving information of the current weather to the Government and the public:—

- (1) India Daily Weather Report and Chart.
- (2) Weekly Weather Report, published in the *Gazette of India* every Saturday, and giving an account of the weather and of the rainfall of the week ending previous Tuesday.
- (3) Monthly Weather Report, giving a general summary of the more important features of the weather of the month and the variations from the normal meteorological conditions of the period, also published in the *Gazette of India*.

79. The daily report in its present form appears to give a fairly complete view of the current weather and of its variation from the normal, and is, I believe, in both these respects one of the most complete issued by any Meteorological Department.

80. The following is a summary of the distribution list of the India Daily Weather Report as it stood on the 31st of March 1890:—

	Number of recipients on the 31st March 1889.	Number of recipients on 31st March 1890.
Commissioners	21	21
Deputy Commissioners	46	45
Assistant Commissioners	3	3
Collectors	34	34
Editors	3	3
Miscellaneous	132	132
Foreign recipients	27	33
Additional copies for office record, &c.	15	16
TOTAL	281	287

81. The weekly and monthly weather reports were published in the same form last year as in 1888-89, the only difference being that complete rainfall data were given in the weekly reports for the whole year, instead of for the south-west monsoon period only. As soon as the changes contemplated in the registration of rainfall, and the publication of the rainfall data have been effected, I propose to take up the question of the changes in the monthly report that are desirable, in order to make it more satisfactory and complete than it is at present.

82. The Simla office prepared weekly charts (drawn by hand), showing the progress of the south-west monsoon rains of 1889 up to date during the period 15th May to 15th October, for the use of His Excellency the Viceroy and the Secretary to the Government of India in the Revenue and Agricultural Department.

83. The Calcutta office prepared four series of average rainfall seasonal charts of the whole of India, as in previous years, for the information of the Government of India and the Secretary of State.

84. *Bombay Daily Weather Report and Chart.*—The circumstances, leading up to the issue of a daily weather report and chart at Bombay for the use of the mercantile community, were fully stated in last year's Administration Report. The following extract from the Administration Report of the Meteorological Reporter for Western India describes its preparation during the past year:—

"The arrangements mentioned in the last year's report were all complete, and from the 16th of May the Bombay office commenced the publication of daily weather report and chart for the purpose of giving information to the mercantile community of the weather along the west coast of India and in the chief cotton and wheat-producing districts, on which the trade of Bombay is largely dependent. According to the new arrangements sanctioned by the Government of India, 42 telegrams are received from various parts of the country, of which 13 are received from the coast stations and 29 from the land stations. Their names are as follows:—

Coast Stations.

Masulipatam.
Madras.
Negapatam.
Colombo.
Cochin.

Calicut.
Mangalore.
Karwar.
Goa.
Ratnagiri.

Bombay.
Surat.
Karachi.

Inland Stations.

Jacobabad.
Ajmere.
Deesa.
Rajkot.
Neemuch.
Indore.
Delhi.
Agra.
Cawnpore.
Jhansi.

Allahabad.
Saugor.
Jubbulpore.
Hoshangabad.
Khandwa.
Raipur.
Nagpur.
Amraoti.
Akola.
Secunderabad.

Sholapur.
Poona.
Malegaon.
Belgaum.
Bellary.
Bangalore.
Coimbatore.
Cuddapah.
Trichinopoly.

"The observations telegraphed are those recorded daily at the observatories at 8 A.M. The telegrams begin to arrive about 9-15 A.M. The report embodying the observations is ready for despatch to the Central Press at about 11-30 A.M., and the summary and chart at about 12-45 P.M. On Mondays and Thursdays additional information, consisting of weather and crop reports from the following stations, is also prepared from telegrams and printed on the back of the daily report:—

Agra.
Delhi.
Cawnpore.
Beawar.
Nagpur.
Amraoti.

Khamgaon.
Barshi.
Sholapur.
Bellary.
Hubli.
Dhulia.

Jalgaon.
Broach.
Wadhwan.
Verangaon.
Dhollera.
Bhavnagar.

"Besides the above, weekly rainfall statements from 48 stations on the Great Indian Peninsula, Rajputana, Malwa, and Bombay, Baroda and Central India Railways were received on each Monday from the 1st July to the 15th October, and were incorporated with the weather and crop reports. Short reports, containing information of the weather experienced in the Arabian Sea by the Peninsular and Oriental Company's mail steamers, have also been published weekly in the report. The system thus sanctioned appears to be very satisfactory."

85. The chart and observations are very neatly and expeditiously printed at the Bombay Government Press. Mr. Hutchinson and the Bombay Meteorological Office deserve much credit for the very satisfactory manner in which the report was issued under somewhat adverse circumstances during the past year.

86. It was stated in last year's report that the arrangements made for the publication of the report were temporary, as the contribution of the Chamber of Commerce, which enabled the report to be commenced, was only granted definitely for one year, but with a promise that it would be continued if the report was found to give the information that was desired by the members of that body. Fortunately the report met with the approval of the Chamber, and I learnt before the end of the year that the Chamber were prepared to continue their contribution, but wished that arrangements should be made to expedite its publication, so that it might be placed in the hands of members of the Chamber not later than about 2 to 3 P.M. daily. There were three directions in which changes could be made to hasten the publication of the report and to place it at an earlier hour in the hands of subscribers. The first was to have the weather messages despatched from the more distant-reporting stations by urgent or ordinary telegrams, instead of by ordinary or deferred telegrams; the second was to increase the strength of the Bombay Office, and thus enable the data to be more quickly tabulated and the report to be sent earlier to the Press; and the third was to engage a larger number of messengers to deliver the reports, when printed, to subscribers. So far as I could judge the report was printed very smartly and quickly at the Government Press, and in fact as expeditiously as could reasonably be expected. I also ascertained that whilst the Government of India were prepared to consider and sanction increased telegraphic allowance in connection with the Bombay Report, there was no hope of obtaining a grant for additional office establishment. The Chamber of Commerce, I had reason to believe, were willing to increase their contribution. The report and chart were, however, largely utilised by the Port Officer and

other officers of the Port Trust, although that body had refused to make any contribution during the experimental period of its publication; because its members disapproved of the arrangements made by the Government of India in connection with the reduction of the Western India Reportership from a whole-time to a half-time appointment. I thought it would hardly be fair to ask the Chamber of Commerce to increase their contribution, until I had learnt whether the Port Trust would re-consider their decision and subscribe towards its support in an improved form. I proceeded to Bombay in December to lay the matter before the Port Trust and to make arrangements for placing the publication of the report on a permanent basis. A meeting was held at the Port Trust Office, attended by Colonel Merewether, Chairman of the Port Trust, Sir Henry Morland, Port Officer, Mr. Beauport, President of the Chamber of Commerce, Mr. Hutchinson and myself, in which the defects of the report and the improvements and additions desired were discussed. The Port Trust eventually agreed to contribute under certain conditions the same amount as the Chamber of Commerce.

This additional amount, together with the contribution by the Chamber of Commerce, enabled Mr. Hutchinson to make the following permanent increase to the Bombay Office :—

1 Tabulator.	2 Clerks.
1 Draughtsman.	4 Messengers.

A small portion of the amount was utilised in giving a slight addition to the pay of the establishment, in order to give them an interest in the work and to compensate them for the harder work they have to perform and for Sunday attendance at office. These additions and changes were made from the 1st April 1890, and have, I believe, effected the improvements desired. The Government of India sanctioned these arrangements and also the additional expenditure necessary to improve the transmission of the telegrams from the more distant stations, and thus expedite the receipt of the weather telegrams by the Bombay Meteorological Office.

87. *Bengal Weather Reports.*—The Calcutta Meteorological Office published the following reports during the year :—

(1st) *Daily Weather Report and Chart of the Bay of Bengal.*—This is prepared in connection with the Bay of Bengal Storm Signal Service, and is chiefly circulated amongst commercial and mercantile men in Calcutta. It includes the 8-A.M. observations taken at 25 stations on and near the coast of the Bay of Bengal from Tavoy to Negapatam and Galle. The usual time at which the report is printed, and is ready for distribution, is between 10-30 and 11 A.M., and it is in the hands of the great majority of the Calcutta subscribers before noon. No change was made in its form during the year. It was supplied to 23 paying subscribers (subscription Rs 2 per mensem) and to 43 non-paying recipients, chiefly Government officers. It was published daily throughout the whole year. The receipts from subscribers during the year covered the cost of printing the reports in the office, and of distributing them.

(2nd) *The Bengal Daily Weather Report.*—This is prepared and issued chiefly for the information of the Government of Bengal and its District Officers to show the progress of the south-west monsoon rains and to give current meteorological information to the Government during the period of the year when it is of the greatest value. It was published in 1889 during

the period April 27th to November 2nd, and gave information based on telegrams received from 42 observatories in Bengal and Assam. It was distributed to 101 non-paying and to 15 paying subscribers (chiefly mercantile firms in Calcutta interested in accurate rainfall data).

(3rd) *The Bengal Weekly Meteorological Report* published in the *Calcutta Gazette*, giving the weekly means of observations at 52 meteorological observatories in Bengal and Assam, and complete rainfall data of 255 rainfall-registering stations in Bengal for the previous week, and a summary of the chief features of the weather during the week.

(4th) *The Bengal Monthly Meteorological Report*, also published in the *Calcutta Gazette*, gives the monthly means of the meteorological data furnished by 47 observatories in Bengal and Assam, and complete rainfall data of the province (including the returns of 251 rain-gauge stations), and a full discussion of the weather and meteorology of the month. In connection with this, three sets of rainfall charts showing the actual rainfall of the month, the variation from the normal rainfall of the month, and the variation expressed as a percentage, are prepared from these data for the information of the Bengal Government and Sanitary Commissioner.

(5th) A summary of the more important features of the south-west monsoon of 1889, with a very full statement of the distribution of the rainfall in the province during the monsoon period, for the information of the Government of Bengal. A series of hand-drawn charts embodying the chief features was prepared for the information of the Bengal Government. The summary was published in the *Calcutta Gazette* of December 18th, 1889.

Both the monthly and weekly reports have been published regularly throughout the year in the *Calcutta Gazette*. The date of publishing of the monthly reports has been in almost every case that of the second Gazette after the close of the month in question, while each Gazette has dealt with the weather statistics of the week up to and including the Friday previous to its issue.

A general report of the meteorology of Bengal for 1888, giving a meteorological summary for the whole year, was prepared and submitted to Government in July for incorporation in the Bengal Administration Report. It was illustrated by maps showing the actual rainfall of the year, and its percentage variation from the normal.

88. In the North-Western Provinces and Bombay, monthly abstracts of the observations of the several observatories, and, in the former, weekly rainfall reports were published in the *Local Government Gazettes* during the year, and, in the Punjab a descriptive summary of the weather of the province was prepared monthly in the Simla office for the information of the Punjab Government and published in like manner. The Madras Reporter published a monthly statement of rainfall in the *Fort St. George Government Gazette*.

89. The Simla office drew up a preliminary report giving a summary of the weather in 1888, which was published in the *Gazette of India*. The Reporters for the Punjab and Western India drew up brief sketches of the meteorology of their respective provinces in 1888-89, the Reporter for the North-Western Provinces for the year 1888, for the information of their respective Governments.

ANNUAL REPORTS AND OCCASIONAL PUBLICATIONS.

90. The Administration Reports of the various Provincial Reporters for the year 1889-90 (utilised in the preparation of the present report) were received on the following dates:—

Bombay	2nd June 1890.
North-Western Provinces and Oudh	16th June „
Bengal	22nd July „
Madras	13th Aug. „

Those for the year 1888-89 were received on the following dates:—

Bombay	3rd June 1889.
Bengal	10th „ „
North-Western Provinces	14th „ „
Madras	29th „ „

The Administration Report for the year 1888-89 was prepared shortly after the receipt of the Provincial Administration Reports, printed in Calcutta, and submitted to Government on the 4th December 1889.

91. The Annual Report on the Meteorology of the previous year, 1888, was finished and placed in the printer's hands in September 1889, and was submitted to Government on the 26th February 1890. It gives tables of temperature for 140 stations, and rainfall returns for 508 stations, being a decrease of one in the case of the former and an increase of one in that of the latter, on the numbers respectively given in the Report for 1887. The returns of the other meteorological elements are nearly as numerous as those of temperature and are practically the same in number as the corresponding returns in the two previous annual reports.

The descriptive letter-press discusses the chief characteristics of the meteorology of the year and includes tables of the average values of all the more important meteorological elements for all stations that have furnished returns for three years and upwards. The report is illustrated with five plates, *viz.*, a chart showing the position of all observatories and rain gauge stations, three in coloured lithography, representing the mean distribution of temperature, pressure and winds in each month of the year, and one showing the tracks of the storms which originated in the Bay of Bengal and the Arabian Sea during the year.

92. The original observations of seven observatories, *viz.*, Calcutta, Lucknow, Allahabad, Lahore, Nagpur, Bombay and Madras, were issued in monthly parts. Those forming the volume for 1888 were completed in May 1889.

93. The following occasional publications were issued during the year:—

(1st) The Hand-Book of Cyclonic Storms in the Bay of Bengal for the use of sailors by the Meteorological Reporter to the Government of India was issued in February 1890.

(2nd) Part II of the Cyclone Memoirs containing an account of the cyclonic storm of August 1888, at the head of the Bay of Bengal, drawn up by Mr. Pedler, Meteorological Reporter to the Government of Bengal, was issued in April 1890.

94. The following is almost ready for issue, *viz.*:—

Part III of the Cyclone Memoirs, giving an account of the Cyclonic Storm

of September 13th to 20th, 1888, and of the Cyclone in the Bay of Bengal in the last week of October 1888 and the *Vartarna* storm of November 1888 in the Arabian Sea.

95. The following have been sent to Press and will be issued as Part VII of Volume IV of the Indian Meteorological Memoirs, *viz.* :—

(1st) The relation between Sunspot and Weather, as shown by meteorological observations taken on board ships in the Bay of Bengal during the years 1855 to 1878, by Mr. Dallas, First Assistant Meteorological Reporter to the Government of India.

(2nd) Account of the Storm of first week of June 1887 in the Arabian Sea, by Mr. F. Chambers, late Meteorological Reporter for Western India.

(3rd) The Meteorology and Climatology of Afghanistan, based upon information obtained from the records of the Afghan Delimitation Commission, by Mr. Dallas.

96. The following are in course of preparation and are nearly ready for publication :—

(1st) Catalogue of the Cyclonic Storms in the Arabian Sea from 1648 to 1889, with a description of their distribution and tracks in the different months of the year, by Mr. Dallas.

(2nd) Account of the Cold-weather Storms of the years 1876 to 1889, in Northern India, by the Meteorological Reporter to the Government of India.

SPECIAL INVESTIGATIONS.

97. The chief series of observations lying in the Calcutta office and awaiting discussion are—

(1st) Hourly Observations taken at 26 stations during the year 1875 to 1890.

(2nd) Anemographic Observations taken at 14 stations.

(3rd) Observations recorded by the automatic autographic instruments at Calcutta, Allahabad, and Jeypore.

98. Of these the most important are undoubtedly the first. They were commenced by Mr. Blanford with a view to furnish ample data for a complete discussion of the diurnal changes of pressure, temperature, aqueous vapour pressure, and cloud in different periods of the year in different parts of India, to ascertain the relations between these meteorological features under the varying conditions prevailing in India and to enable the causes of the diurnal oscillations of the barometer in India to be fully worked out, if possible, from the data. It appeared to me that Mr. Blanford was best qualified in every way to deal with these observations which he had initiated, and by far the greater part of which were taken under his instructions and general superintendence. I wrote to him and asked him if he would take up these observations and discuss them fully in the way that he originally intended when he commenced these observations, or with any modifications suggested by his experience. After some correspondence, it was finally arranged that he should first deal with the data for each station separately, give the results of each in short memoirs, and then compare the results, and work out the conclusions deducible from them in a general discussion. A separate volume of the Indian Meteorological Memoirs will be devoted to these papers.

PART II.—DETAILS OF ADMINISTRATION.

METEOROLOGICAL OFFICERS.

99. The general administration of the meteorological observatories and offices in the different provinces has been in the hands of the following officers during the year:—

Names.	Office.	Provinces.
John Elliot, Esq., M. A., F.R. MET. SOC.	Meteorological Reporter to the Government of India .	Central Office.
W. L. Dallas, Esq.	First Assistant Meteorological Reporter to the Government of India .	
C. Little, Esq., M.A.	Second Assistant Meteorological Reporter to the Government of India .	
J. H. Gilliland, Esq., B.A. (Offg.) .	Personal Assistant to the Meteorological Reporter to the Government of India .	
Lala Hem Raj		
A. Pedler, Esq., F.C.S.	Meteorological Reporter to the Government of Bengal.	Bengal and Assam.
C. Little, Esq., M.A. (Offg.)		
J. R. Holt, Esq., C.S. (Offg.)	Meteorological Reporter to the Government of the North-Western Provinces and Oudh	North-Western Provinces, Oudh, Rajputana, and Central India (part).
W. N. Boutflower, Esq., B.A. (Offg.) .		
S. A. Hill, Esq., B.Sc., F.R. MET. SOC.		
W. L. Dallas, Esq.	Meteorological Reporter to the Government of the Punjab	Punjab.
S. A. Hutchinson, Esq.	Meteorological Reporter for Western India	Bombay, Berar, Rajputana, and Central India (part).
Miss Isis Pogson, F.R. MET. SOC. . .	Meteorological Reporter to the Government of Madras .	Madras, Mysore, Coorg, and Hyderabad.
Dr. G. C. Chesnaye	Sanitary Commissioners, Central Provinces	Central Provinces.
Dr. J. Richardson		
Dr. J. G. Pilcher		
Dr. C. Little	Sanitary Commissioner, Berar	Berar.
Dr. D. Sinclair	Sanitary Commissioner, Burma	Burma.

100. Mr. H. F. Blanford retired on the completion of his furlough on the 7th of May 1889.

101. Mr. C. Little was appointed Second Assistant Meteorological Reporter to the Government of India from the 8th of May 1889. The duties assigned to him are—

(1st) The superintendence of the Alipore Observatory, including the control of the Time Ball operations.

(2nd) The superintendence of the verification and issue of instruments, and the examination of doubtful observations in the monthly registers, except those from Bengal stations.

(3rd) To have charge of the library, the receipt and issue of books, &c.

(4th) To superintend the work in connection with making and recording extracts from the log books of ships arriving in Calcutta.

It was also arranged that he should learn the work of the Bay of Bengal Storm Signal Service as early as possible, in order to take up these duties whenever necessary.

102. Mr. Little acted as Meteorological Reporter to the Government of Bengal during

the absence of Mr. Pedler on privilege leave from the 5th August to the 29th October 1889. Mr. Gilliland, Professor of Mathematics in the Presidency College, acted for Mr. Little during this interval.

103. Mr. Hill was on furlough during the greater part of this year. Mr. J. R. Holt, C.S., acted for Mr. Hill as Professor of Physics in the Muir College and as Meteorological Reporter to the Government of the North-Western Provinces. Mr. Holt had a sun-stroke in May, which completely broke down his health, and he was ordered home as soon as he was able to move. He left on the 31st July. Mr. W. N. Boutflower, Professor of the Muir College, was, after an interregnum lasting until the 25th August during which the Head Clerk had current charge of the office, appointed to act as Reporter. Mr. Hill returned to duty on the 5th of December 1889.

OBSERVATORIES.

104. At the commencement of the year under report there were in all 165 observatories in India contributing registers of meteorological data. The observations of 22 were utilised only in the preparation of the daily and other reports issued by the Bengal Section of the Calcutta office.

105. Observatories were opened at the following stations during the year :—

Cawnpore	on 1st October 1889.
Khushab	on 1st January 1890.
Montgomery	on 1st January 1890.
Veraval	on 1st February 1890.
Ahmednagar	on 26th February 1890.
Mozufferpore	on 3rd April 1890.

106. The observatories at Khushab (near Shahpur) and Montgomery were established to give meteorological information of the Central Punjab districts. The observatories in existence previously were either situated near the Indus or near to the hills in the East Punjab, and hence the central districts (Montgomery, Jhang, and Shahpur) were not represented. The Montgomery Observatory worked very successfully from the first. The Khushab Observatory was less fortunate, as about three months after its establishment the majority of the instruments were wantonly broken one night. The culprit was fortunately discovered, tried and convicted to one month's imprisonment for destroying about ₹300 worth of Government property. The Ahmednagar Observatory was established to give information of one of the driest areas in the Bombay Deccan. Its observations are utilised in the India Daily Weather Report. The circumstances which led to the establishment of an observatory at Veraval were fully stated in last year's report, and need not be repeated. The establishment of the observatory at Mozufferpore was due to the representations of Messrs. Kilburn & Co. of Calcutta, who pointed out that it was the centre of one of the most important indigo districts in Behar, and that meteorological information from that station would be of great service to the indigo-planting community. The observations taken at that station are utilised in the Bengal Weather Report which circulates amongst the leading produce merchants in Calcutta. The observatory at Cawnpore was established chiefly at the instance of the Bombay Chamber of Commerce in connection with the Bombay Daily Weather Report. It gives meteorological data of a very important cotton district which was before very imperfectly represented

by Lucknow. The observations are utilised both for the India and Bombay Daily Weather Reports. The sites at Khushab and Montgomery were selected and the observatories established by Babu Jaspat Rai, Chief Observer, Lahore Observatory. Those at Cawnpore and Muzzufferpore were selected by Babu Chandi Charan Chatterjee, late Inspector, and those at Veraval and Ahmednagar by myself. All except Khushab have worked satisfactorily since their establishment.

107. Voluntary observatories were established during the year at Shortt's Island near Chandbally and at Lungleh in the Chittagong Hill Tracts. Observations were also obtained for the first time from the independent observatories at Bhavnagar and Trivandrum maintained by the Rajahs of Bhavnagar and Travancore respectively.

108. The observatories maintained by the Government of India are classified as follows:—

First Class—Observatories which are furnished with autographic instruments for recording pressure, temperature, humidity, rainfall and wind direction and velocity, either continuously or at intervals of 10 minutes, or which take special solar actinometric observations.

Second Class—Observatories at which observations are taken at 8 hours which (with one or two exceptions) are transmitted to Simla by weather telegrams and are included in the India Daily Weather Report, and also at 10 and 16 hours.

Third Class—Observatories which are of two kinds—

(a) those at stations where there are telegraph offices and which record 8 hours' observations only for transmission daily to Simla, Bombay, or Calcutta by weather telegrams;

(b) those at which there are no telegraph offices and which record 10 and 16 hours' observations, in some cases for inclusion in the annual report and in others to furnish a series of 11 years' observations, and thus enable monthly and daily means to be obtained for these stations which shall be comparable with those already obtained for the second class observatories.

Fourth Class—Observatories at which observations of temperature and rainfall only are recorded.

109. The following gives the arrangement of the observatories maintained by the Government of India, or supplied with instruments by the Meteorological Department, and working in connection with it, according to this classification, on the 31st of March 1890:—

BENGAL AND ASSAM.

	Class.		Class.		Class.
Calcutta (Alipore)	1st	Durbhanga	3rd	Balasore	3rd
Berhampur	2nd	False Point	"	Bankoora	"
Burdwan	"	Hazaribagh	"	Bhagulpur	"
Chittagong	"	Patna	"	Bogra	"
Cuttack	"	Saugor Island	"	Burrisal	"
Dacca	"	Sibsagar	"	Buxar	"
Darjeeling	"	Silchar	"	Chupra	"
Dhubri	"	Arrah	"	Chyebassa	"

BENGAL AND ASSAM—continued.

	Class.		Class.		Class.
<i>Comilla</i>	3rd	Midnapore	3rd	<i>Ranchee</i>	3rd
<i>Dehree</i>	"	Motihari	"	<i>Ranigunj</i>	"
Dinagepur	"	<i>Mozufferpore</i>	"	<i>Rungpur</i>	"
<i>Furreedpore</i>	"	Mymensingh	"	<i>Serajgunj</i>	"
Gya	"	<i>Noakholly</i>	"	Shortt's Island	"
Jessore	"	<i>Nya-Doomka</i>	"	Tezpur	"
Julpigoree	"	Pedong	"	Calcutta (Chowringhee)	4th
<i>Krishnaghur</i>	"	<i>Poorce</i>	"	Demagiri	"
Lungleh	"	Purneah	"	Mongpoo	"
Maldah	"	<i>Rampur-Bauleah</i>	"	Tura	"

NORTH-WESTERN PROVINCES.

	Class.		Class.		Class.
Allahabad	1st	Bareilly	3rd	Gorakhpur	3rd
Agra	2nd	Benares	"	Jhansi	"
Lucknow	"	Cawnpore	"	Mussooree	"
Meerut	"	Chakrata	"	Pithoragarh	"
Ranikhet	"	Dehra	"		
Roorkee	"	Ghazipur	"		

PUNJAB AND KASHMIR.

	Class.		Class.		Class.
Lahore	1st	Peshawar	2nd	Khushab (Shahpur)	3rd
Simla	"	Chamba	3rd	Montgomery	"
Ludhiana	2nd	Delhi	"	Rawalpindi	"
Mooltan	"	Dera Ismail Khan	"	Sialkot	"
Murree	"	Kailang	"	Sirsa	"

CENTRAL PROVINCES.

	Class.		Class.		Class.
Hoshangabad	2nd	Raipur	2nd	Saugor	3rd
Jubbulpore	"	Chanda	3rd	Seoni	"
Khandwa	"	Pachmarhi	"	Sironcha	"
Nagpur	"	Sambalpur	"		

BERAR.

	Class.		Class.		Class.
Akola	2nd	Buldana	3rd	Makhla	3rd
Amraoti	3rd	Chikalda	"		

CENTRAL INDIA AND RAJPUTANA.

	Class.		Class.		Class.
Ajmere	2nd	Bickaneer	3rd	Neemuch	3rd
Nowgong	"	Indore	"	Pachpadra	"
Sutna	"	Mount Abu	"	Sambhar	"

BOMBAY.

	Class.		Class.		Class.
Belgaum	2nd	Poona	2nd	Hyderabad	3rd
Deesa	"	Ratnagiri	"	Malegaon	"
Jacobabad	"	Sholapur	"	Rajkot	"
Karwar	"	Ahmednagar	3rd	Surat	"
Karachi	"	Bhuj	"	Viraval	"

MADRAS.

	Class.		Class.		Class.
Bellary	2nd	Calicut	3rd	Madras (Port Office) . .	3rd
Cochin	"	Coconada	"	Mangalore	"
Mercara	"	Coimbatore	"	Masulipatam	"
Salem	"	Cuddalore	"	Negapatam	"
Secunderabad	"	Cuddapah	"	Nellore	"
Trichinopoly	"	Gopalpore	"	Rajahmundry	"
Wellington	"	Kurnool	"		
Bangalore	3rd	Madura	"		

BURMA.

	Class.		Class.		Class.
Akyab	2nd	Bassein	3rd	Moulmein	3rd
Diamond Island	"	Bhamo	"	Tavoy	"
Mergui	"	Kindat	"	Thyetmio	"
Rangoon	"	Mandalay	"	Toungthoo	"

BAY ISLANDS.

	Class.		Class.
Port Blair	2nd	Cocos Island	3rd

EXTRA INDIA.

	Class.		Class.
Aden	2nd	Bushire	3rd
Leh	"	Katmandu	"
Quetta	"	Meshed	"
Amini Divi	3rd	Seychelles	"
Baghdad	"	Zanzibar	"

110. In the list of Bengal and Assam Observatories the stations given in italics at present contribute observations only to the Bengal Reporter.

111. The important Government observatories of Bombay and Madras are independent of the Department, and publish separate annual reports for the information of Government.

112. Cocos Island, Demagiri, Ghazipur, Lungleh, Meerut, Mongpoo, Nowgong, Pedong, Shortt's Island, and Tura are voluntary observatories, in which the instruments are supplied by the Meteorological Department, but the observations are taken by some local arrangement (and generally by volunteer agency).

113. The observatory at Makhla is maintained by the Forest Department for the purpose of recording special observations bearing on the influence of forests on rainfall.

114. Observations are regularly furnished to the Department by the following independent observatories:—

- (1) *Vizagapatam*—An excellent private astronomical and meteorological observatory established in 1871 by the late J. V. Juggarow, Esq., and now maintained by A. V. Nursingrow, Esq., F.R.A.S., F.R.G.S.

- (2) *Jeypore*—An admirable observatory provided with a complete set of autographic instruments and maintained at the expense of the Maharaja of Jeypore.
- (3) *Goa*—An astronomical and meteorological observatory maintained by the Portuguese Government.
- (4) *Trivandrum*—A meteorological observatory maintained by the Maharaja of Travancore.
- (5) *Bhavnagar*—An excellent tidal and meteorological observatory established and maintained by the Thakur of Bhavnagar.

115. It may also be mentioned that regular observations are taken on board the light vessels at the entrance to the River Hooghli in accordance with arrangements made by the Port Commissioners and are furnished regularly to the Department. They are chiefly utilised in the discussion of the cyclonic storms of the Bay of Bengal. Registers of observations were received from the following light vessels during the year:—

F. L. V. Star, stationed at the *Intermediate Station* from April to November 1889, at the *Mutlah Station* from December 1889 to 17th January 1890, and at the *Lower Gasper Station* from 18th January to 28th February 1890.

F. L. V. Meteor, stationed at the *Mutlah Station* from April to November 1889.

F. L. V. Canopus, stationed at the *Ridge Station* from May to October 1889, and at the *Mutlah Station* from 18th January to 4th March 1890.

Character of Work at Observatories during the year.

FIRST CLASS OBSERVATORIES.

116. *Alipore Observatory*.—This observatory is the largest and most important under the direct management of the Department. On the appointment of Mr. Little as Second Assistant Meteorological Reporter to the Government of India, the Alipore Observatory was placed under his charge. It is furnished with a complete set of autographic instruments, including a sunshine recorder, a Kew barograph and thermograph, a Beckley's anemograph, an Osler's anemometer, and a Beckley's rain-gauge. All instruments that are issued to Indian observatories are carefully tested at the observatory, and their corrections ascertained before they are sent out for use. Another important part of its work is the dropping daily of two time-balls at 1 P.M., local mean time for the port of Calcutta. The work of the observatory was described in full detail in the Administration Report of 1886-87 (page 18). No change has been made either in the work or the establishment of the observatory since that date.

117. The self-registering instruments have worked satisfactorily during the past year, and the photographic traces have been generally clear and distinct. The measurements from the traces of the barograph and thermograph have been compared with the eye-readings of the standard barometer and the wet and dry bulbs in the same manner as in

the previous four years (*vide* Administration Report of 1886-87, page 18). The following gives the mean differences for the past five years:—

	1885.	1886.	1887.	1888.	1889.
Mean difference between the standard barometer and barograph during the year (<i>i.e.</i> , standard barometer <i>minus</i> barograph)	+ '025"	+ '026"	+ '027"	+ '026"	+ '024"
Mean difference between the dry-bulb in the thermometer shed and the dry-bulb trace of the thermograph (<i>i.e.</i> , thermograph <i>minus</i> shed dry-bulb thermometer)	+ '4°	+ '5°	+ '6°	+ '7°	+ '7°
Mean difference between the wet-bulb in the thermometer shed and the wet-bulb trace of the thermograph (<i>i.e.</i> , thermograph <i>minus</i> wet-bulb thermometer)	+ '6°	+ '5°	+ '7°	+ '8°	+ '7°

118. The number of instruments verified during the year and the previous four years (given for comparison) is shown by the following table:—

Instruments.	1885-86.	1886-87.	1887-88.	1888-89.	1889-90.
	Number.	Number.	Number.	Number.	Number.
Barometers	42	52	52	74	46
Aneroids	27	10	15	16	20
Dry and wet-bulb thermometers	8	62	31	41	36
Standard thermometers	5	1	8	...	...
Maximum thermometers for air temperature	7	45	6	50	28
Minimum " for " "	27	55	21	45	46
" " for nocturnal radiation	28	18	10	9	14
Solar radiation thermometers	55	20	20	5	19
Common thermometers	2	...	1	2	1
Boiling point thermometers . . . . .	...	6	2	...	...
Travellers' maximum and minimum thermometers, in pairs . . . . .	...	...	1	1	...
Sunshine-recorder . . . . .	...	...	...	...	1
Sling thermometers	5	2	3	...	...
Anemometers . . . . .	...	...	...	...	12
Sand-glasses . . . . .	...	...	...	16	17
Pressure gauge . . . . .	...	...	...	...	1
Salinometers	1	...	...	1	...
Hydrometers . . . . .	...	...	...	1	..
Rain-gauges	17	4	2	...	...
Measure-glasses for rain-gauges	27	4	2	...	...
TOTAL	251	280	174	261	241

This part of the work was carefully superintended during the past year by Mr. Little.

119. The following table gives a statement of the instruments received from England or returned from observatories, or after repair from the Mathematical Instrument Department,

and issued (properly verified) during the past year to the Central Office for distribution to observatories when required :—

Instruments.	Under verification at beginning of year.	Received.	Issued.	Under verification at end of year.
Barometers . . . . .	...	63	61	6
Aneroids . . . . .	...	14	16	...
Dry and wet-bulb thermometers	4	39	41	16
Maximum thermometers for air temperature	8	62	36	9
Minimum " for " "	2	39	46	10
" " for nocturnal radiation . . . . .	...	16	17	4
Solar radiation thermometers . . . . .	...	26	20	10
Common thermometers . . . . .	...	1	1	...
Standard " . . . . .	...	12	...	...
Boiling point thermometers . . . . .	...	4	...	...
Sand-glasses . . . . .	...	30	25	...
Dial anemometers . . . . .	...	24	17	4
Sun-shine recorder . . . . .	...	1	1	...
Centimeter . . . . .	...	1	...	...
Pressure-gauge . . . . .	...	1	1	...
TOTAL	14	333	282	59

These numbers show a large increase on the corresponding numbers for the preceding year (*viz.*, 261 receipts and 216 issues).

120. The time signal work has been performed satisfactorily during the past year. The time-ball on the Semaphore Tower, Fort William, and that on the roof of the Port Commissioners' Office were accurately dropped on all days, Sundays and holidays inclusive, except on the undermentioned days, when it failed to drop properly for the reasons given in the table :—

Date of failure.	Nature of failure.	Cause of failure.
8th July 1889	Time-ball at the Port Commissioners' Office dropped about one second after mean 1 P.M.	Defect in telegraphic communication.
20th August 1889	Ditto ditto ditto ditto	Ditto ditto.
23rd August 1889	Time-ball at the Port Commissioners' Office failed altogether.	Ditto ditto.
10th September 1889	Ditto ditto ditto ditto ditto	Ditto ditto.
17th September 1889	Ditto ditto ditto ditto ditto	Ditto ditto.
20th September 1889	Time-ball on the Semaphore Tower, Fort William, dropped about three seconds after mean 1 P.M.	Ditto ditto.

Date of failure.	Nature of failure.	Cause of failure.
31st January 1890 .	Time-ball on the Semaphore Tower, Fort William, dropped about one minute before mean 1 P.M.	The coil of the electromagnets of the time-ball trigger on the Semaphore Tower broke, and consequently the electromagnets became demagnetized and the ball dropped itself.
3rd February 1890 .	Time-ball at the Port Commissioners' Office failed altogether.	It was reported that the workmen at the Port Commissioners' Office could not get the key of the door leading to the roof on which the time-ball is set up.
20th March 1890 .	Time-ball on the Semaphore Tower, Fort William, dropped about four or five seconds after mean 1 P.M.	Defect in telegraphic communication.

121. *The Allahabad Observatory.*—The following account of the condition of this observatory is taken from the Report of the Meteorological Reporter to the Government of the North-Western Provinces :—

"The Allahabad observatory is furnished with one of Van Rysselberghe's electrically recording meteorographs. The same troubles which have attended the use of this instrument at Jeypur have constantly been met with in an aggravated form at Allahabad, the chief difficulty being with the battery. When I went away in March 1889, the meteorograph was in good order, and it continued to work fairly well up to the end of June. From June till December no plates worth keeping came from the instrument; but in December it was taken in hand by Mr. Zuberbühler, of the firm of Messrs. Hanhart & Co., an experienced Swiss clockmaker, who had helped to set up a similar instrument on the Säntis Peak in his native country, and who put it to rights in such a manner that it gave fairly good traces for the next three months, though the battery was a constant difficulty. As Mr. Zuberbühler left India in March, and in the absence of an expert such as he is, the meteorograph was likely to be always a very costly instrument to maintain, whilst giving extremely unsatisfactory results, its use was finally abandoned at the end of the year under report. Since the beginning of the current year, a temporary establishment has been entertained for the purpose of making hourly observations day and night until such time as a set of automatic instruments suitable to the climate can be provided. During the year eye-observations of all the more important instrument were recorded daily at 6 A.M., 8 A.M., 10 A.M., 4 P.M., and 10 P.M., the thermometers in the thermograph pent-house were read three times every day; a set of earth thermometers was observed three times a day; daily observations were made of a battery of radiation thermometers and occasional observations of the movement of clouds, and an automatic record of sunshine was maintained without a break."

122. It was stated in last year's report that the meteorograph at Allahabad, after having been repaired by its maker in Europe, was set up again at Allahabad, but worked almost as unsatisfactorily as before its repair. Mr. Holt devoted much attention to it last April and May, and experimented in various battery arrangements, but failed to make it work steadily and satisfactorily in the hot weather. Mr. Boutflower, when he took over charge of the observatory after Mr. Holt was invalided home, asked Mr. Zuberbühler to report on the condition of the instrument. His report showed that it had been very carelessly and imperfectly repaired in Europe. Before finally condemning the instrument Mr. Zuberbühler was asked to repair it thoroughly in the hope that it might perhaps work satisfactorily. He spent a very considerable amount of time on it, with the result that it worked fairly well for a few days, and then developed new faults which required further repairs. Finally Mr. Zuberbühler, before leaving the country, recommended the importation of a new type of voltaic battery from Germany at a cost of some R300 or R400, and held out hopes that the meteorograph might work satisfactorily by the use of that battery during the hot weather. As Mr. Zuberbühler's skilful treatment had however failed to make it work satisfactorily with the means available in India, Mr. Hill suggested that the

instrument should be condemned as unfit for observational work in India, and other arrangements be made for equipping the Allahabad Observatory, and I gave orders accordingly. It may be noted that the instrument was sent to Allahabad in December 1885. Mr. Hill used every means to make it work properly, but failed in consequence of various defects which could not be repaired in India. It was returned to the instrument-maker for repairs in May 1887 and sent back in May 1888, and after eighteen months' further effort to work it, it has at last been found necessary to condemn it as utterly unsuited to the climatic conditions of India.

123. *The Lahore Observatory* was converted into a first class observatory on the 1st of January 1889. It is provided with a complete set of self-registering instruments, including a Draper's barograph, sun thermometer and hygrometer, a Beckley's anemograph, and a Beckley's self-registering rain-gauge. Seven sets of eye-observations are taken daily from the ordinary instruments in the thermometer shed, and observations of ground temperature and sunshine. I inspected the observatory on two occasions during the year, and found everything in good order. The Draper's barograph gave very good results during the year. The thermograph is much less satisfactory,—it not only fails to record properly sudden changes of temperature, but it lags behind, recording the maximum and minimum temperature of the day from one to two hours after the hours of their actual occurrence, and hence also giving a diminished range of temperature during the day. The wet-bulb arrangements are specially unsatisfactory, and it is very doubtful whether they can be modified so as to be adapted to the very dry climate of Lahore. Various changes were made by the Chief Observer at my suggestion, which have effected some improvement, but the latest examination of the thermograms by Mr. Dallas shows that even yet they are by no means satisfactory, and that it is not possible from the present results to determine satisfactory corrections for the actual readings. It will hence probably be necessary to have recourse to eye-readings of the wet and dry bulbs at intervals of five or ten minutes, to see whether, during the present year, the instrument cannot be adapted to the climatic conditions of India.

SECOND AND THIRD CLASS OBSERVATORIES.

124. The great majority of these have worked very satisfactorily during the past year, and the quality of the observations has also improved to some extent. Small fines are now imposed for careless or erroneous observations exceeding a certain number, and this has helped to make some observers more careful. An examination recently made of the 4 P.M. observations (which are not charted in the way that the 8 A.M. observations are charted for the daily report), showed that there are a much greater number of errors in these observations than in the morning observations, and that observers are evidently much less careful in taking and recording them. Arrangements will be made during the present year for the 4 P.M. observations to be charted systematically with a view to the detection and elimination of errors in these observations in future.

SPECIAL OBSERVATIONS.

125. Amongst the special observations taken at a small number of stations are—

1st.—Observations recorded by self-registering wind instruments or anemographs at 15 stations.

2nd.—Solar and terrestrial radiation observations at 29 stations.

3rd.—Seismic observations at Sibsagar and Silchar in Assam.

4th.—Special storm observations.

126. The following gives a list of the observatories at which anemographic observations were taken during the year, and also shows the amount and character of the work done :—

STATION.	Anemograms supplied.	How much reduced and tabulated at the Calcutta Meteorological Office up to the end of official year.	Character of Anemograms.
Belgaum . . .	1st April 1889 to 15th March 1890 .	1st April to 31st December 1889.	Distinct.
Calcutta (Alipore) . .	1st April 1889 to 31st March 1890, except from noon of the 4th January 1890 to 8 A.M. of the 5th, when the clock stopped, and from 11 A.M. to 1 P.M. of the 7th January 1890, when the clock was being oiled and cleaned.	1st April 1889 to 31st March 1890, except from noon of the 4th January 1890 to 8 A.M. of the 5th, and from 11 A.M. to 1 P.M. of the 7th January 1890.	Ditto.
Chittagong . . .	1st April to 29th October 1889; 1st November 1889 to 12th January 1890; 15th January to 31st March 1890.	1st April to 31st December 1889.	Ditto.
Darjeeling . . .	1st April 1889 to 31st March 1890 .	1st to 30th April 1889 .	Papers not properly adjusted.
Deesa . . .	1st April 1889 to 7th January 1890; 11th to 15th January 1890; 19th January to 31st March 1890.	1st April to 31st December 1889.	Faint, but measurable.
Dehra . . .	1st April to 2nd June 1889; 4th June to 1st August; 3rd to 26th August; 28th to 31st August; 2nd September 1889 to 31st March 1890.	Ditto ditto .	Ditto ditto.
Dhubri . . .	24th October 1889 to 31st March 1890.	None . . .	Distinct.
Hazaribagh* . . .	1st April 1889 to 31st March 1890 .	Ditto .	Ditto.
Jubbulpore . . .	17th May to 5th June 1889; 7th to 17th June; 26th to 27th June; 29th June to 9th December; 24th December 1889 to 31st March 1890.	17th May to 31st December 1889.	Papers not properly adjusted.
Lahore . . .	7th June to 7th July 1889; 9th to 11th July; 15th July 1889 to 28th January 1890; 30th January to 31st March 1890.	7th June to 31st December 1889.	Ditto ditto.
Lucknow . . .	1st April to 1st December 1889; 9th December 1889 to 31st March 1890.	1st April to 31st December 1889.	Distinct.
Nagpur . . .	1st April 1889 to 31st March 1890 .	Ditto ditto .	Ditto.
Rangoon . . .	Ditto ditto .	Ditto ditto .	Ditto.
Roorkee . . .	1st April to 19th September 1889; 21st September 1889 to 31st March 1890.	Ditto ditto .	Ditto.
Saugor Island . . .	1st April 1889 to 31st March 1890 .	1st April to 30th June 1889 .	Ditto.

* Casella's embossing anemograph.

Beckley's anemograph was in use at all stations, except Hazaribagh, where a Casella's embossing anemograph was utilised. The anemograms were satisfactory in the great majority of cases, and show that due care had probably been exercised by the observers. The traces at Darjeeling and Jubbulpore were unsatisfactory in consequence of the failure of the observers to adjust the papers properly.

127. The following gives a list of the stations at which solar and grass radiation observations were taken daily throughout the year and of the work actually performed during the year 1889-90:—

STATIONS.	Period for which radiation observations were taken and sent in to the Central Office.
Aden (a)	April to October 1889, and December 1889 to March 1890.
Allahabad	Throughout the year.
Bombay	Ditto.
Calcutta (Alipur)	Ditto.
Coimbatore	Ditto.
Darjeeling (b)	Ditto.
Deesa	Ditto.
Dhubri (c)	August 1889 to March 1890.
Hazaribagh (c)	Throughout the year.
Jeypore	Ditto.
Lahore	Ditto.
Leh	Ditto.
Lucknow	Ditto.
Ludhiana (c)	Ditto.
Madras	Ditto.
Mount Abu (c)	Ditto.
Murree (c)	Ditto.
Mussooree (d)	Ditto.
Nagpur	Ditto.
Pachmarhi (c)	Ditto.
Poona (d)	Ditto.
Rangoon (e)	Ditto.
Ranikhet	June 1889 to March 1890.
Rawalpindi (c)	Throughout the year.
Roorkee (c)	Ditto.
Saugor Island (c)	Ditto.
Sibsagar	June 1889 to March 1890.
Simla	August 1889 to March 1890.
Vizagapatam	Throughout the year.
Wellington	Ditto.

(a) Grass radiation thermometer observations from May 1889 to March 1890.

(b) No grass radiation thermometer observations.

(c) Grass radiation thermometer observations from June 1889 to March 1890.

(d) Ditto ditto ditto from July 1889 to March 1890.

(e) No grass radiation thermometer observations.

The solar radiation observations were taken in the same manner as in the year 1888. It was thought that by having observations taken at a small number of stations and from three instruments at each station, consistent results might be obtained. An examination of the observations of 1889 shows that they are utterly discordant. Different instruments exposed at the same station under, so far as can be judged, absolutely identical conditions give widely different results. Before finally deciding to discontinue these observations as hopelessly unsatisfactory in consequence of apparently irremediable imperfection in the instrument itself, I thought it best to hand over the observations for 1889 to Mr. Hil for independent opinion. After subjecting them to a thorough examination, he gave the following opinion:—

“I have gone through all the observations of the solar radiation thermometer made in 1889 with the greatest care after applying the previously determined corrections for instrumental errors, and have arrived at the following conclusions:—

- (1) There is no advantage whatever in attempting to correct the observations to a common standard. The uncorrected readings in many, if not most, cases agree better than those to which the corrections have been applied. A few days' observations under identical conditions are not sufficient to determine the correction with any approach to accuracy. The thermometers are so variable in their indications that in one (ordinary) case which I have worked out it would seem that at least 44 months' comparative readings would be required to furnish an average correction with a probable error of only one-tenth of a degree.

- (2) The differences between the indications of two thermometers placed side by side are in very many instances subject to an annual variation, showing that the correction to a common standard cannot be made by adding or subtracting a fixed quantity, but that the amount of this correction is variable, perhaps capable of being expressed as a function of the temperature indicated. This, I believe, has already been pointed out by Mr. Whipple, of Kew Observatory.
- (3) The older thermometers, even after correction, on the whole, give lower readings than the newer ones. Some of the latter, when compared with the oldest thermometer of the set, appear to fall off considerably in sensitiveness, even in the short period of twelve months. It is not, however, always the newest thermometer which shows this falling-off most distinctly; sometimes an instrument two or three years old decreases in sensitiveness more rapidly than a perfectly new one; sometimes also an instrument after remaining nearly constant in its indications for several months (as compared with the oldest of the set) suddenly shows a rapid and unaccountable falling-off in sensitiveness.
- (4) The indications of instruments are thus in most cases totally unreliable and the observations consequently worthless. The only possible exceptions I can see to this sweeping condemnation are observations made with instruments which have been in constant use for ten years or more, and which may perhaps be assumed to have arrived at a constant condition as regards sensitiveness."

As it is now certain the observations of these instruments under the conditions which obtain at the great majority of our stations can lead to no useful results, and are utterly useless for scientific investigation, they will be discontinued at all stations, except, perhaps, the first class observatories, from the end of the present year.

STORM OBSERVATIONS.

128. A considerable number of storm observations were sent in during the year 1889. A fair proportion of these were very complete, and gave valuable information respecting the storms with which they dealt. The best and most complete on the whole were those furnished by the observers at Allahabad, Neemuch, Coconada, Masulipatam, and Port Blair. The Neemuch observer collected very valuable information from neighbouring stations in addition to his observations. The observers at Saugor Island, Akyab, Gopalpur, Delhi, Agra, Sirsa, Ludhiana, Roorkee, Karwar, Sutna, Akola, and Jubbulpore sent in full and good reports of every important storm which passed over their observatories, and the greater part of their observations were evidently taken very carefully. The remaining observations were in some cases good, but in the majority of cases too limited to be of much use. It was carefully pointed out in the circular giving instructions to observers for the record of observations during storms, that—

"what was required was not hasty and unintelligent observations of every storm, large or small, by observers, but a careful and as complete a series of observations as possible of the larger storms of the various kinds mentioned in the circular. A full series of observations of a single storm made with accuracy, judgment and intelligence will be of more use to the department than fifty taken carelessly and hastily and without judgment."

The amounts that were awarded for the work of storm observations in 1889 are given below. They depend partly upon the number of series of storm observations taken, but chiefly upon the extent and value of the meteorological information sent in. In estimating the amounts the greatest importance was attached to the extent and quality of the observations as complete records of the storms during which they were taken. For example, the Port Blair observer sent in a very complete and important series of observations, extending over four days, of the very squally and unsettled weather which preceded and accompanied the formation of one of the cyclonic storms of the year in the Bay of Bengal. He was hence awarded as much for this one long series of observations as some

observers were granted for five or six short series of observations during thunderstorms, &c.:—

Station.	Name of Observer.	Number of storm reports.	Amount.	Station.	Name of Observer.	Number of storm reports.	Amount.
			<i>R</i>				<i>R</i>
Agra . . .	L. Pandya . . .	6	25	Mount Abu . .	M. M. Talati . .	5	20
Allahabad . .	Kadernath Chatterjee .	6	60	Malegaon . . .	B. Doorganna . .	1	1
Akola . . .	Samuel Gregory . .	19	50	Masulipatam .	T. Rajaram Row .	8	60
Amraoti . . .	J. W. Hollay . . .	1	2	Madras . . .	J. R. Gonsalves . .	6	30
Ajmere . . .	R. Pershad . . .	7	15	Nagpur . . .	P. Soobia . . .	1	5
Akyab . . .	J. J. Brown . . .	7	30	Neemuch . . .	A. H. Garston . .	6	60
Bagdad . . .	J. J. Nelson . . .	1	2	Nellore . . .	D. Conn . . .	3	20
Benares . . .	R. R. Pathak . . .	2	4	Peshawar . . .	Abdul Jabbur . .	3	10
Burdwan . . .	Mokhadapersad Choudhuri.	2	10	Pithoragarh . .	Sher Singh . . .	2	5
Balasore . . .	R. M. Dass . . .	2	5	Pedong . . .	Revd. A. Desgodins .	8	30
	U. C. Mitter . . .	9	25	Patna . . .	Surjun Singh . . .	1	2
Bhuj . . .	S. Samuels . . .	4	15	Pachmarhi . . .	A. Runganaidoo . .	3	5
Belgaum . . .	R. D. Madurkar . .	1	5	Poona . . .	V. B. Joshi . . .	4	10
Comilla . . .	Braja Nath Deb . .	6	5	Port Blair . . .	G. T. Carroll . . .	1	15
Chikalda . . .	J. R. Ratman Das . .	1	5	Roorkee . . .	Chiranji Lall . . .	4	15
Coconada . . .	C. Gaétave . . .	6	60	Ranikhet . . .	Ram Ruttun . . .	1	2
Cuddalore . .	P. M. Courtinga . .	2	10	Rampore Bauleah	S. N. Banerjee . .	1	1
	K. Subramanetty . .	1	5	Ratnagiri . . .	M. Cuddum . . .	1	5
Delhi . . .	Bansidhar . . .	14	40	Sirsa . . .	M. C. Mahomed . .	9	30
Deesa . . .	G. P. Nesti . . .	4	10	Sibsagar . . .	D. Barua . . .	1	3
Furreedpore .	N. C. Mozoomdar . .	1	1		J. H. Peters . . .	16	35
False Point . .	J. London . . .	2	15	Saugor Island . .	A. E. T. Greene . .	1	5
Gya . . .	Balmookoond Lall . .	1	10		J. A. Thomas . . .	1	10
Gopalpur . . .	J. Narain Moorty Naidu	15	50	Seoni . . .	Puncham . . .	14	60
Hazaribagh . .	Nathoo Lall . . .	1	5	Sutna . . .	Harnath . . .	12	30
Hoshangabad .	Behari Lall . . .	4	10				
Hyderabad . .	Satramdass Ramchand	13	25				
Jubbulpore . .	S. Dubay . . .	11	30				
Jacobabad . . .	Shaik Ali . . .	3	5				
Jeypore . . .	Durga Pershad . . .	8	10				
Karwar . . .	G. Arango . . .	8	30				
Ludhiana . . .	Brij Lall . . .	17	40				
Mooltan . . .	Wahid Ali . . .	1	2				
Mymensing . .	S. C. Saha . . .	3	15				

INSPECTION OF OBSERVATORIES.

129. The following table shows the amount of inspection done during the year:—

PROVINCE.	INSPECTED BY		Native Inspector.
	Imperial Reporter.	Assistant or Provincial Reporter or Sanitary Commissioner.	
Bengal	Bhagulpore	Hazaribagh Darjeeling Julpigoree Rungpore Dhubri Burdwan Purneah Bankoora	Burdwan. Purneah. Bhagulpore. Durbhunga. Motihari. Chupra. Patna. Gya.
North-Western Provinces and Oudh.	Allahabad. Mussoorie Roorkee Lucknow Cawnpore	Lucknow. Cawnpore Agra Jhansi	Jhansi. Lucknow. Gorakhpur.
Punjab	Lahore. Delhi. Ludhiana.		
Central India and Rajputana	Ajmere Mount Abu Sutna . . . . .	..... ..... .....	Sutna. Indore. Neemuch.
Central Provinces	Jubbulpore Hoshangabad	Nagpur Chanda Khandwa Hoshangabad Seoni Raipur Saugor.	Jubbulpore. Hoshangabad. Khandwa. Raipur. Saugor.
Berar	Akola Amraoti . . . . .	..... .....	Akola. Amraoti.
Bombay	Deesa. Veraval. Bhavnagar Rajkot Surat. Ahmednagar.	..... .....	Poona. Sholapore.
Madras	Madras (Port Office observatory)	Bangalore. Masulipatam. Mercara. Rajahmundry.	
Burma	Rangoon. Thayetmyo. Toungthoo. Mandalay. Moulmein.		
Bay Islands	Port Blair.		

This makes a total of 75 observatories inspected during the year. Twenty-nine were inspected by myself, 23 by the Native Inspector, and 23 by the Provincial or Assistant Reporters or Sanitary Commissioners. A much larger amount of inspection was done than in the previous year.

130. The following observatories were in a high state of efficiency and thoroughly satisfactory in every respect at the time of inspection :—

Allahabad.	Mount Abu.	Roorkee.
Hazaribagh.	Port Blair.	Agra.
Poona.	Nagpur.	Rangoon.
Sholapore.	Lahore.	Moulmein.
Burdwan.	Cawnpore,	Chanda.
Durbhunga.	Patna.	Masulipatam.

131. The following were in a satisfactory state. There were one or two slight defects, chiefly in the instruments or in the thatching of the shed, which were in the majority of cases rectified at the time of inspection, and in the other cases as soon afterwards as was possible :—

Sutna.	Amraoti.	Mussoorie.
Delhi.	Raipur.	Ajmere.
Khandwa.	Saugor.	Deesa.
Toungchoo.	Bhagulpore.	Surat.
Thayetmyo.	Motihari.	Purneah.
Indore.	Julpigoree.	Seoni.
Neemuch.	Rungpore.	Bangalore.
Akola.	Ludhiana.	Mercara.

132. The following gives the inspection reports of Jhansi, Dhubri, Lucknow, Jubulpore, Rajkot, and Rajahmundry, which were in a more or less unsatisfactory condition at the time of their inspection :—

Jhansi.—The observatory was inspected on the 15th, 16th and 19th June by the Native Inspector, the chief object of the visit being to determine the cause of the continued low readings of the barometer. It was found that the observer did not adjust the mercury surface to the fiducial point, as was suspected by the Meteorological Reporter, and that in consequence his readings were at the time too low by amounts ranging from '01" to '02". The wet-bulb thermometer was slightly encrusted. The wind vane was rusty from want of oil, and the anemometer very dirty. The observer, it was ascertained, read the anemometer erroneously, and it is hence almost certain that the previous wind observations are of no value. It was thus necessary for the Native Inspector to spend three days in teaching the observer and in remedying the defects at this station.

Dhubri.—Was inspected on the 22nd, 23rd and 24th October by Mr. Gilliland. The chief object of the visit was to start the new Beckley's anemograph and to instruct the observer in its working.

The following extracts are taken from his report :—

"I found the inside of the anemograph house very dirty with cobwebs, &c., and the recording apparatus, especially the cylinder, dirty with old oil which had dropped from the roof.

"The observer seems a very punctual and, on the whole, intelligent man, more anxious, however, to impart than to receive instruction. Like the observers at Julpigoree and Rungpore, he did not know how to set the barometer vernier. Ordered each day to clean the recording cylinder, &c., of the anemograph, he regularly failed to do so, and gave as his excuse that he required a second man. He received my instructions and explanations as to his future duties with respectful indifference, repeatedly referring me to Article 95 of the Vade Mecum to prove that the instrument must be set daily, and, therefore, two men are required. I took considerable pains to endeavour to remove this impression.

"The following instruments were out of order or unsuitably placed :—

- (1) Fortin's barometer (L. Casella, No. 974) had the mercury in the cistern so badly oxidized, and the ivory point so dirty, that it was quite impossible to determine the fiducial point. I accordingly determined to clean it, and gave the observer particular instructions to hold the tube in a particular position. Unfortunately he turned his head suddenly and jerked up the open end of the tube, so that some air got in. The instrument had consequently to be sent to Calcutta.
- (2) Solar radiation thermometer (Nos. 57562, Negretti and Zambra) had got the top of the stem broken. It still registered, however, nearly the same as the others.
- (3) Rain-gauge, Negretti and Zambra, stood in a bad position, and was surrounded with jungle. It had no fence round it.
- (4) All the sun thermometers were shaded by the anemograph house from about 3-30 P.M., but there was no better place for them.

The thatch of the thermometer shed was very bad, and there was no ventilator."

Lucknow.—This observatory, which some years ago was one of the best in Northern India, has recently been far from satisfactory. The wind observations were frequently doubtful, or evidently erroneous, in 1888. The observer's attention was called time after time to the errors, but no satisfactory explanation was received. The Native Inspector was sent in June 1889 to ascertain the actual state of the observatory, and find out, if possible, the cause of the erroneous wind observations. The following extracts are given from his report :—

"The barometer is hung in the north-west wall of a room in the museum, and is well lighted by a window to the right, and suitably placed.

"The thermometers were all in order, but the wet-bulbs were thickly encrusted and the muslin and thread very dirty. The bottle was dirty. The solar and grass radiation thermometers were in good order.

"The anemograph was in good order and well lubricated, but the direction rod moved with difficulty in consequence of the great friction due to its rubbing against a part of the beam. The wind vane, which had been recently supplied by the Calcutta office to give the wind direction for the daily weather telegram, had been set up very loosely on the top of a packing case, and the north-pointer was nearly 90° out pointing due west.

"The anemometer No. 639, also sent at the same time as the wind vane, was useless, as the cogs were worn and the upright spindle did not catch all the ribs. The fact ought to have been brought to the notice of the Calcutta office and a new instrument obtained. The shed was in good order and clean. The observer read the instruments correctly."

I called upon the observer for an explanation of the disgraceful state of the wind-recording instruments, and pointed out that these defects explained the erroneous observations of which I had complained. In reply he denied the truth of the statements in the inspection report of the Native Inspector, and asserted that the Inspector had made these statements from personal reasons. An inquiry finally showed that there was no foundation for these assertions, and that the inspection report faithfully represented the state of the observatory, and it was hence necessary to fine the observer severely.

In order to verify the statements of the Inspector, I thought it desirable to visit the Lucknow Observatory in the beginning of the cold weather. I found the thermometers generally in good order. The anemometer, a new one from Calcutta, was very loosely fixed, and wearing away very rapidly with the constant oscillatory motion it had. The wind vane was stuck into a hole in a box placed on a table upon the roof of the museum. The whole arrangement was so shaky that it was certain to be blown over in a strong wind. The steel parts of the anemograph were much rusted, and the whole instrument worked very heavily and failed to indicate the true direction, except in very strong winds. The condition of the wind-recording instruments was most discreditable and a disgrace

to the observer. Instructions were given for the following changes to be at once carried out:—

- (a) Erection of a pillar on which to fix the wind vane.
- (b) Anemometer to be rigidly attached to wall.
- (c) Small ladder to be purchased to enable observer to reach and clean anemograph more easily.
- (d) Steps to give easy access to wind vane, &c.

The observer was also instructed to submit an estimate of cost of thoroughly cleaning anemograph from rust, &c.

Mr. Hill visited the observatory in December. He found it generally in good condition. The orders given above had been carried out with respect to the wind vane and anemograph. Nothing had been done to the anemometer. Mr. Hill had it securely fixed and carefully cleaned and oiled. He had also found out certain irregularities in the observer's method of taking the wind observations. The conduct of the observer has hence been most unsatisfactory throughout. It is much to be regretted that the observer, who was for many years one of the most accurate and trusted of the observers in Northern India, should have become so careless and indifferent to his work and to the condition of his instruments and observatory. He has given the Department much trouble during the past twelve months, and it will take several years' careful performance of his duties to regain the former opinion of his superior officers.

Jubbulpore has also given much trouble during the past twelve months. The observer has been on duty many years, and has, until recently, been very favourably reported upon, and considered as one of our most intelligent and trustworthy observers. His observations for some time past have been occasionally vitiated by errors apparently either due to very careless reading of the instruments, or to reading them at incorrect hours, or some other flagrant cause. When his attention was called to the erroneous observations, he usually insisted on their accuracy, and endeavoured to prove that the instrument or the Meteorological Office was at fault.

The observatory was thoroughly inspected by Babu Chandi Churn Chatterjee in May last, when he remained about nine days in order to remedy defects in the setting up of the Beckley's anemograph, which had been erected there by the Public Works Department, and to train the observer to use the instrument properly. He reported favourably of the condition of the observatory. As the observations continued to be occasionally erroneous, more especially the 4 P.M., I determined to visit the observatory myself, and ascertain whether the observer was punctual in his observations. I visited it first on the 10th December on my way to Bombay. The observer took the 8 A.M. observations punctually, but failed to attend the observatory at 10 A.M. or 4 P.M. He subsequently excused himself on the plea of slight illness. He had, however, failed to report his illness to the Superintendent, and the explanation which he gave was not considered satisfactory by the Superintendent of the observatory. I visited the observatory a second time on my return from Bombay on the 16th and 17th February. The observer was punctual in taking the 8 A.M. and 10-hours observations, but did not arrive until 4-30 P.M. to take the 4 P.M. observations.

Rajkot Observatory was inspected by myself on the 7th of February. It had not been visited for several years. The thatching of the shed was in very bad condition, and instructions were given for its immediate renewal. The instruments for recording the force and direction of wind were placed at the top of a wooden staging about 30 feet high, which gave a very good exposure to the instruments, but was in a shaky condition. The present observer informed me that the preceding observer whom he succeeded about a year previously considered the staging unsafe, and hence never ascended it, and observed the reading of the anemometer from the foot of the ladder. It was not possible to verify this statement, but it throws a very considerable doubt upon the accuracy and value of previous observations. The barometer was a small Fortin hanging freely, and with a vernier adjusted directly by hand. The mercury was much oxidized, and the scale divisions nearly obliterated. It was hence very difficult to read, and the observer deserved much credit for reading it so accurately as he did. The dry-bulb maximum and minimum thermometers were in good order. The wet-bulbs had evidently not been cleaned for years, as the encrustation formed a solid mass from an eighth to a quarter of an inch thick. The wind vane was in fair order, but the anemometer was an old instrument, much worn, and with the wheels and screws all very loose. It was unfit for use. The observer ascribed the defects to his not being properly taught to keep the instruments in order by the previous observer when he made over charge. A new barometer was left, the wet-bulb thermometer carefully cleaned, and the observatory placed in a satisfactory condition. The observer was found to be intelligent and anxious to take the observations properly.

Rajahmundry was inspected by Miss Pogson, Reporter for Madras, on the 18th, 19th, 21st and 22nd October, and reported as follows:—

“The observatory barometer (Casella, No. 1275) on the Kew principle was clean and in excellent condition. It was hanging on the northern wall with only a single light from a door on the same side, and the observer complained of the difficulty of reading it on dark days. I found that he was in the habit of lifting off the cage, loosening the fixing screws in the iron ring at the lower end, and twisting the instrument round to the light—a most objectionable method—disturbing the mercury just before each observation and putting the instrument out of position. This was explained to the observer, and he was desired to discontinue the practice; nevertheless the very next time I went to the observatory the cage was down, and he was repeating his own process. After suspending my comparison barometer (Casella, No. 713) on the eastern wall with light from the north and south, and finding this a much more favourable position for reading the vernier, the observatory barometer (Casella, No. 1275) was removed to the centre of the same wall.

“The thermometer shed is fairly well situated as regards exposure, and was in good condition. The thermometer cage was clean, properly fixed, and in good preservation. The maximum and minimum thermometers were hung in too slanting positions to ensure accuracy in their readings, so they were altered and put almost horizontal. The only perfect thermometers in use were the maximum No. 9876, Negretti and Zambra, and the dry minimum Casella No. 29805, which were allowed to remain. Comparative observations showed that both the wet-bulb and wet minimum thermometers were reading three or four degrees too low, and on taking off the muslin and examining the bulbs, these instruments were found to be completely encrusted with thick deposits, making the glass bulbs appear like stones. The observer's explanation was that he used the Godavary river water, and was not aware that it would damage the instruments. The end of the wet minimum was broken off, and the tube consequently shifted backwards and forwards. The defective thermometers were consequently exchanged for new ones. No anemometer or wind vane has as yet been erected, difficulties having been raised regarding a staging. On consulting Dr. Evans, the medical officer in charge of the observatory, however, he said he saw no objection to their being placed on the roof of the Civil Dispensary, on a small raised platform with a suitable step-ladder to reach them, and promised to make enquiries of the Executive Engineer, and to have the matter attended to. This he has kindly done, and arrangements are now in progress for their erection.”

METEOROLOGICAL OFFICES.

133. The Calcutta branch of the India Meteorological Office and the Bengal Meteorological Office were combined into one office, and placed under the Head Clerk, Babu Fanindra Mohan Basu, with effect from the 1st January 1889. The Simla branch of the India Meteorological Office has been considerably extended, and performs a very much larger portion of the work of tabulation and other office details than formerly. In addition to these offices are the local meteorological offices at Bombay, Allahabad, and Madras of which the first alone issues a Daily Weather Report.

134. The following table states the number of registers of observations reduced and tabulated in the several meteorological offices during the year 1889-90 :—

PROVINCE.	CALCUTTA.		SIMLA.	ALLAHABAD.	BOMBAY.	MADRAS.
	8-h. registers.	10-h. & 16-h. registers.	8-h. registers.	10-h. & 16-h. registers.	10-h. & 16-h. registers.	10-h. & 16-h. registers.
Bengal and Assam	47	17	...	...	...	...
North-Western Provinces and Oudh . . . . .	...	...	12	7	...	...
Punjab . . . . .	...	3	13	4	...	...
Rajputana and Central India	1	...	8	3	...	...
Central Provinces . . . . .	...	8	8	...	...	...
Berar . . . . .	...	1	2	...	3	...
Bombay	1	1	13	...	8	...
Madras, Mysore and Coorg	1	1	20	...	...	7
Burma	1	4	11	...	...	...
Bay Islands	1	2	...	...	...	...
Extra Indian	3	5	1	...	...	1
TOTAL	55	42	88	14	11	8

135. The non-departmental observatories of Madras and Jeypore send their observations into the Calcutta Meteorological Office fully tabulated, and require no further reduction. Those received from the non-departmental observatories at Bombay and Vizagapatam require partial reduction and slight re-arrangement in the Calcutta Office. The observations sent in by all voluntary observatories are submitted on forms supplied by the Department and are reduced in the meteorological offices.

136. The more important duties of the Calcutta Office, in addition to the tabulation of the 97 registers enumerated above, are—

- (a) The working of the Bay of Bengal Storm Signal Service.
- (b) The preparation of the Bay of Bengal Daily Weather Report and Chart, and of the Provincial Daily Weather Report during the south-west monsoon period.
- (c) The preparation of the Bengal Weekly and Monthly Meteorological and Rain-fall Reports published in the *Calcutta Gazette*.
- (d) The preparation of the Annual Reports on the Meteorology of India, and of the data for the majority of the special papers and investigations published by the India Meteorological Office.

- (e) The issue of all instruments to observatories.
- (f) The collection of meteorological data for the Bay of Bengal from all ships entering the port of Calcutta.
- (g) The collection of daily rainfall data for Bengal and from a large number of stations in India, and the preparation of monthly and annual rainfall and weather statements for the Secretary of State for India, and of various sets of rainfall charts.

137. The chief duties of the Simla Office, in addition to the work of reducing and tabulating the observations of 88 stations, are :—

- (1) The working of the West Coast of India Storm-warning Service.
- (2) The issue of flood and other warnings to certain Public Works and other officers.
- (3) The preparation and issue of the India Daily Weather Report, and of Weekly and Monthly Meteorological Statements for the *Gazette of India*.
- (4) The collection of rainfall data for the whole of India and the preparation of Weekly Rainfall Reports and Charts.

138. The chief duties of the Bombay Office, in addition to the reduction and tabulation of the observations of eleven stations, are as follows :—

- (1) The preparation of the Bombay Daily Weather Report and Chart.
- (2) The collection of meteorological data for the Arabian Sea from vessels entering the port of Bombay.
- (3) The tabulation of rainfall data for Bombay.

139. The Allahabad and Madras Meteorological Offices, in addition to tabulating the observations of the second class observatories in their respective provinces, collected the provincial rainfall data during the year and published weekly or monthly returns in the local Gazettes.

140. The following is a list of the number of ministerial officers and menial servants in the several meteorological offices at the end of the year 1889-90 :—

	INDIA AND BENGAL.		North-Western Provinces.	Western India.	Madras.	Total.
	Calcutta.	Simla.				
Head Clerks	1	1	1	1	1	5
Inspector	1(a)	...	...	...	...	1
Computers	2	1	...	...	...	3
Clerks and Copyists	7	...	1	1(b)	2	11
Tabulators	21	13†	3	6	...	43
Draughtsmen	3	3	...	1(b)	...	7
Artisans	3*	...	...	...	...	3
Peons and menials	13†	8	2	4(c)	2	29

(a) Vacant since September 1889.

(b) Paid from contribution of the Bombay Chamber of Commerce for the Bombay Daily Report.

(c) Two of these are paid from contribution of the Bombay Chamber of Commerce for the Bombay Daily Report.

* Paid from subscriptions to Bay of Bengal Daily Weather Report.

† Two of these are paid from subscriptions to Bay of Bengal Daily Weather Report.

‡ Including one actinometric observer.

141. An unusually large amount of special work has been done by the meteorological offices (chiefly Calcutta) during the year. The daily sums and means of the data mentioned in paragraph 78 of last year's Administration Report were worked out during the early part of the year for the months of May to December. As already stated in paragraph 22, the employment of 30 temporary clerks during the months of January and February 1890 was sanctioned for the tabulation in a special manner suited for ready reference, and for the calculation of monthly, weekly, or daily means, &c., of the rainfall data collected and accumulated in the respective Provinces of India. Twenty-five of these were employed at Calcutta to tabulate the rainfall data of the North-Western Provinces, the Punjab, the Central Provinces, and Assam. This work was completed (with the exception of the calculation of the means) during these two months.

Five clerks were employed at Bombay for the same period to tabulate a portion of the rainfall data of that area. Finally, a sum of Rs500 was sanctioned to pay for the work of tabulating the 22 years' available data for the Madras rainfall-registering stations. Miss Pogson made special arrangements in order to have the work carried out rapidly and satisfactorily at Madras.

Hence by far the greater part of the rainfall data was tabulated before the end of the year, and is now available for future reference in the Calcutta Office, and special arrangements will be made in order that the record may in future be kept up to date.

142. The number of rainfall stations which sent returns to meteorological offices in 1889-90 is as follows :—

Bengal	255 stations.
North-Western Provinces and Oudh	274 „
Madras	316 „

143. Babu Fanindra Mohun Basu, Head Clerk of the Calcutta Central Meteorological Office (or combined India and Bengal Meteorological Offices), has controlled that office with marked judgment and ability during the past year, and assisted largely in adapting the office to the changing and extending requirements of the Department. The Chief Computer of the Calcutta Office, Babu Nirduksha Kumar Ghosh, has carried out his part of the office work with intelligence and skill. Both of these officers took a very great interest in the preparation of the Hand-book of Cyclonic Storms in the Bay of Bengal, and assisted me very materially in the selection and tabulation of the data, and worked out of office hours in order to help me to prepare and complete it as quickly as possible.

144. The Simla Office, of which Babu Allah Buksh is the Head Clerk, has improved very considerably during the past year. Lala Hem Raj, my Personal Assistant, and Babu Amar Singh, Computer, have worked very zealously and intelligently, and assisted largely in the preparation of the Daily Report and the special investigations carried out by Mr. Dallas and myself during the year.

145. The Provincial Reporters report favourably of the work of their respective offices. The Bombay Meteorological Office has done exceptionally good work during the past year, and has adapted itself readily to the extended requirements of issuing the

Daily Weather Report and collecting marine data. This, in the opinion of the local Reporter, and I am able from my own experience founded on several recent visits to Bombay to confirm, is very largely due to the intelligence and practical zeal and energy of the Head Clerk, Mr. Ganesh Shadashiv.

146. The Provincial and Assistant Reporters have contributed even more largely than usual to the efficient and satisfactory working of the Department during the past year. Mr. Hill, Meteorological Reporter to the Government of the North-Western Provinces and Oudh, especially has rendered me the most valuable assistance in considering and settling the most important scientific questions in connection with meteorology during the past year. He was ever ready to give any assistance in such questions, and his wide scientific knowledge and special acquaintance with the science and literature of meteorology made his assistance especially valuable. The assistance he gave me in the consideration of the value of the solar radiation observations is an illustration of the services he rendered to the Department in addition to the ordinary duties of his meteorological appointment.

Mr. Dallas, Assistant Meteorological Reporter to the Government of India, has worked the West Coast of India Storm-warning Service, and Messrs. Pedler, Meteorological Reporter to the Government of Bengal, and Little, the Bay of Bengal Storm-warning Service, carefully and efficiently, and have suggested improvements or helped me in carrying out the minor changes effected during the year in the methods of performing the storm-warning duties suggested by experience.

Special credit is due to Mr. Hutchinson, Meteorological Reporter for Western India, and the Head Clerk, Mr. Ganesh Shadashiv, for the very successful manner in which they initiated the publication of the Bombay Daily Weather Report and Chart.

Miss Pogson, Meteorological Reporter to the Government of Madras, gave very useful and ready assistance in tabulating the rainfall of the Madras Presidency. The various returns prepared by her office are models of neatness, and are the strongest evidence of the careful supervision that she exercises over her department and office.

INSTRUMENTS.

147. The following table gives the return of the instruments in store at the beginning and end of the year, and of those received and issued by the India Meteorological Office during the year to the various meteorological offices and departments, and includes the stock, receipts, and issues of the Alipore Observatory :—

Return of the Stock, Receipt, and Issue of Instruments for the year 1889-90.

INSTRUMENTS.	In store, 1st April 1889.	Received, 1889-90.	Issued, 1889-90.	In store on 31st March 1890.
Barometers, observatory, Fortin's principle	26	40	35	31
" " Kew " 	3	3	...	6
" mountain portable tripod (Adie)	20	12	2	30
" marine, Kew principle	21	3	2	22
" Negretti and Zambra (various)	8	8	7	9

Return of the Stock, Receipt, and Issue of Instruments for the year 1889-90—continued.

INSTRUMENTS.	In store, 1st April 1889.	Received, 1889-90.	Issued, 1889-90.	In store on 31st March 1890.
Barometers, Aneroid	12	2	4	10
Hick's Barograph	1	...	...	1
Thermometers, standard, with attached scales	28	7	...	35
" " without " "	6	4	...	10
" for Hygrometers (Kew pattern)	63	47	42	68
" maximum for shade	75	64	47	92
" solar <i>in vacuo</i> (self-registering)	33	35	32	36
" " (non-self-registering)	26	10	...	36
" " not <i>in vacuo</i>	2	...	...	2
" minimum for shade	66	56	59	63
" " for radiation	25	16	14	27
Sling thermometers	14	...	...	14
Chemical "	7	...	...	7
Six's "	7	...	...	7
Common "	1	...	...	1
Travellers' maximum and minimum thermometers, in pairs	5	...	...	5
Frankland's sun thermometers	3	...	...	3
Boiling-point "	7	...	...	7
Thermograph with Negretti and Zambra's sets of recording thermometers	1	...	...	1
Negretti and Zambra's sets of recording thermometers . . . . .	...	1	...	1
Pouillet's Pyrheliometer	1	...	...	1
Stewart's actinometers (thermometers for)	7	...	...	7
" " (chamber for)	1	...	...	1
Hodgkinson's actinometers	2	...	...	2
Herschell's "	1	...	...	1
Regnault's hygrometers	3	1	1	3
Daniel's "	10	1	...	11
Halleur's "	5	...	...	5
Pocket spectroscope (Browning's)	1	...	...	1
Anemometers	44	50	38	56
Wind-vanes	33	5	17	21
Casella's anemographs	1	1	2	...
Electrical anemometers and wind-vanes	3	...	...	3
Rain-gauges (Symons's), 5" diameter	110	3	61	52
" (") 6" "	3	...	...	3
" (") 8" "	3	1	...	4
Measure glasses for 5" rain-gauges	179	8	14	173
" " for 6" "	11	...	1	10

Return of the Stock, Receipt, and Issue of Instruments for the year 1889-90—concluded.

INSTRUMENTS.	In store, 1st April 1889.	Received, 1889-90.	Issued, 1889-90.	In store on 31st March 1890.
Measure glasses for 8" rain-gauges	3	1	1	3
Reading lenses	1	19	12	8
Sun thermometer-stands	13	9	3	19
Radiation thermometer's pads	6	13	5	14
Barometer cages . . . . .	...	15	13	2
Thermometer cages	7	9	7	9
" " for ships	14	2	...	16
Prismatic compasses	1	1	...	2
Magnetic " . . . . .	...	7	2	5
Sand-glasses (3-minute)	47	31	11	67
Sundials	1	2	...	3
Clocks	1	5	6	...
Watches . . . . .	...	29	3	26
Bottles for wet-bulb thermometers	97	1	24	74
Electrophorus	1	...	...	1
Filled tubes for marine Kew principle barometers	5	...	5	...
" " for observatory Kew principle barometers	15	...	1	14
" " for Adie's barometers . . . . .	...	4	...	4
" " Negretti and Zambra's barometer . . . . .	...	1	...	1
Chain for Casella's embossing anemograph	100 ft.	...	6 ft.	94 ft.
Gauges for testing Symons's rain-gauges	1 pair	1 pair	...	2 pairs
Plummet	1	...	...	1
Bull's-eye lanterns . . . . .	...	14	9	5
Bed-plates for anemometers	23	...	6	17
Altitude thermometers . . . . .	...	4	...	4
Hydrometer . . . . .	...	1	...	1
Air-meters . . . . .	...	4	...	4
Instruments, drawing, mathematical . . . . .	...	5 sets	5 sets	...
Parallel ruler . . . . .	...	1	1	...
Traveller's anemometer . . . . .	...	1	...	1
Spring balance . . . . .	...	1	1	...
Measuring tape . . . . .	...	1	...	1
Spirit levels . . . . .	...	2	...	2
Declinometer . . . . .	...	1	...	1
Theodolite . . . . .	...	1	1	...
Sunshine-recorder . . . . .	...	1	...	1
Centimeter . . . . .	...	1	...	1
Draper's self-recording thermometer . . . . .	...	1	...	1

LIBRARY.

148. Appendix A gives a list of the additions to the Library during the past year. It is in good order, except that some of the books have been slightly spoiled by insects. The books are now continuously looked after.

149. Appendix B gives a list of the Government officials, libraries, observatories, societies, &c., to which the publications of the India Meteorological Department are presented, including those which send their own publications in exchange.

JOHN ELIOT,

Meteorological Reporter to the Government of India.

METEOROLOGICAL OFFICE,
Calcutta, 28th August 1890.

APPENDIX A.

Presentations to the Library from the 1st April 1889 to the 31st March 1890.

Place.	Donor.	Title of Work.
ALGERIA . . .	Meteorological Service . . .	{ Bulletin Météorologique du Gouvernement Général del'Algérie, February to December 1889. Bulletin Mensuel, April to December 1888.
	Government of the North-Western Provinces and Oudh.	Minutes of the Managing Committee of the North-Western Provinces and Oudh Provincial Museum, Lucknow, for August 1883 to March 1888.
ALLAHABAD . . .	Land Records and Agriculture Office.	{ First Forecast of the cotton crop of 1889. Final Forecast of the cotton crop for 1889-90. Final Forecast of the Indigo crop for 1889. Wheat and oilseed Forecast for November 1889. Second Forecast of the wheat crop of 1889-90. Ditto of the linseed and rapeseed crop of 1889-90.
AMSTERDAM . . .	Royal Academy of Sciences . . .	{ Jaarboek, 1888. Verslagen en Mededeelingen, Afd. Natuurkunde, Derde reeks, Deel V.
BANGALORE . . .	Chief Commissioner of Coorg . . .	Report on the Administration of Coorg, 1888-89.
BATAVIA . . .	Magnetical and Meteorological Observatory.	{ Rainfall in the East Indian Archipelago, 1888. Observations made at the Magnetical and Meteorological Observatory at Batavia, Volume XI, 1888.
	Gesellschaft für Erdkunden	{ Verhandlungen. Band I to XVI and No. 1 of Band XVII. Mittheilungen der Afrikanischen Gesellschaft in Deutschland, Volumes I to IV, and Parts 1 to 3 of Volume V. Zeitschrift der Gesellschaft für Erdkunde Nos. 121 to 145. Mittheilungen von Forschungsreisenden und Gelehrten aus den Deutschen Schutzgebieten, Parts 1 to 4 of Volume I and Parts 1 to 5 of Volume II.
BERLIN . . .	German and Austrian Meteorological Society.	Meteorologische Zeitschrift, March 1889 to February 1890.
	K. Preussischen Meteorologischen Institut.	Ergebnisse der Meteorologischen Beobachtungen im Jahre 1887 and Jahre 1889 Heft I.
		Tableau graphique des observations hydrométriques Suisses pour le Bassin du Rhin, Aar, Reuss, Limmat, Rhône und Tessin July to December 1888.
		Graphische Darstellung der Lufttemperaturen und der Niederschlags-höhen im Rheingebiet, Aarebiet und Reuss, Limmat, Rhone, Tessin, und Inngebiet January to June 1888.
BERNE . . .	Dept. de l' Interieur de la confederation Suisse.	{ Tableau graphique des températures de l' air et des hauteurs pluviales pour le Bassin du Rhin, pour le Bassin de l' Aar, pour les Bassins de la Reuss, Limmat, du Rhône, du Tessin et de l' Inn July to December 1888. Graphische Darstellung der schweizerischen hydrometrischen Beobachtungen über das Rheingebiet, Aaregebiet, Reussgebiet, Limmatgebiet, Rhônegebiet, and Tessingebiet January to June 1889.

Presentations to the Library from the 1st April 1889 to the 31st March 1890—continued.

Place.	Donor.	Title of Work.
BOMBAY	Government of Bombay .	Twenty-fifth Annual Report of the Sanitary Commissioner for the Government of Bombay, 1888.
	Government Observatory .	Magnetical and Meteorological observations made at the Government Observatory, Bombay, 1887.
	Land Records and Agriculture Office.	Annual Report of the Government Experimental Farm, Hyderabad (Sind), for the year ending 31st March 1889. Crop Experiments, Bombay Presidency, 1888-89.
	Meteorological Office .	Brief sketch of the Meteorology of the Bombay Presidency in 1888-89. Account of the Operations of the Weather Bureau and List of stations. Meteorological Report for 1887. Meteorological Instructions. Meteorological Synopsis of the Brisbane Observatory during January to June 1889.
BRISBANE	Meteorological Observatory .	Monthly Meteorological Summaries taken at Meteorological stations in the Colony of Queensland during January to June 1889. Rainfall Summaries taken at Meteorological stations in the Colony of Queensland during January to June 1889. Telegraphic Code and special notice to observers. Weather Chart of Australasia, 19th January to 19th December 1889.
BRUSSELS	Royal Academy of Sciences .	Bulletins de l' Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique, 3me Série, Tomes XIV to XVII. Annuaire de l' Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique, 1888-89.
	Royal Observatory .	Annuaire de l' Observatoire Royale de Bruxelles for 1885 to 1888. Annales de l' Observatoire Royale de Bruxelles, Série II, Tome II.
BUCHAREST	Institut Météorologique de Roumanie.	Studiu asupra Climei Băcureștilor in Anii, 1885-88, Pt. I. Annales de l' Institut Météorologique de Roumanie pour l' Année 1887, Tome III.
CAIRO	Egyptian Statistical Bureau .	Bulletin Hebdomadaire, Nos. 11 to 52 of 1889 and Nos. 1 to 9 of 1890.
CALCUTTA	Comptroller and Auditor General.	Civil Budget Estimates, 1889-90. Civil Estimates, 1889-90
	Director General of Telegraphs .	Indian Telegraph Guide, October 1889.
	Director General of the Post Office.	Indian Postal Guide, January 1890, No. 33.
	Geological Survey of India .	Records of the Geological Survey of India, Volume XXII, Parts II-IV and Volume XXIII, Part I. The Civil Service Regulations, 1st Edition, 1889.
	Government of Bengal .	Returns of the Rail-borne Trade of Bengal for the quarters ending 31st December 1888 and 31st March, 30th June and 30th September 1889.
		Report on the External Trade of Bengal with Nepal, Tibet, Sikkim, and Bhutan, for the year 1888-89.
		Report on the Rail-borne Traffic of Bengal during the year 1888-89. Report on the River-borne Traffic of Bengal, 1888-89. Report on the Administration of Bengal, 1888-89.

Presentations to the Library from the 1st April 1889 to the 31st March 1890—continued.

Place.	Donor.	Title of Work.
CALCUTTA— <i>contd.</i>	Government of Bengal	Report on the Administration of Bengal, 1888-89, in its relations with Tributary States and Frontier affairs.
		General Report on Public Instruction in Bengal for 1888-89.
		Annual Statistical Returns and brief notes on Vaccination in Bengal for the year 1888-89.
		Divisional Administration Reports of Bengal for 1888-89.
		Resolution reviewing the reports on the working of the District Boards of Bengal during the year 1888-89.
		Revenue Report of the Public Works Department, Irrigation Branch, Bengal, for the year 1888-89.
		Bengal Quarterly Civil List, 1st October 1889, and 1st January 1890.
	Government of India, Home Department.	Twenty-first Annual Report of the Sanitary Commissioner, Bengal, 1888.
		The American Ephemeris and Nautical Almanac, 1889, published by United States Hydrographic Office, Navy Department, Washington.
		List of Civil Officers holding Gazetted appointments under the Government of India in the Home, Legislative, Foreign, and Revenue and Agricultural Departments, corrected to 1st July 1889.
	Government of India, Revenue and Agricultural Department.	The Civil Service Regulations, 1st Edition, 1889.
		Gazetted appointments under the Government of India in the Home, Legislative, Foreign, and Revenue and Agricultural Departments, corrected to 1st January 1889.
		The India Office List, 1889.
	Indian Association for the Cultivation of Science.	Administration Report of the Indian Marine for the year 1888-89.
		Report of the twelfth Annual Meeting of the Indian Association for the Cultivation of Science, held in April 1889.
	Lieutenant-Colonel J. Waterhouse.	Memorandum on the Barisal guns.
	Mathematical Instrument Office	Descriptive Catalogue of Instruments obtainable at the Mathematical Instrument Office.
	Pat Doyle, Esq.	Indian Engineering, Volume V, Nos. 15 to 26, Volume VI, Nos. 1 to 26 and Volume VII, Nos. 1 to 13.
	Sanitary Commissioner with the Government of India.	Twenty-fifth Annual Report of the Sanitary Commissioner with the Government of India, 1888.
	Surveyor General of India	General Report on the Operations of the Survey of India, 1887-88.
		Metric weights and measures and other tables prepared for the use of the Photographic and Lithographic Offices, Survey of India.
	W. R. Williams, Esq.	Bengal Pilot's Vade Mecum, 1889.
CAMBRIDGE (U. S. A.)	Harvard College Observatory	Annals of the Observatory, Volume XX, Part I (observations made at the Blue Hill Observatory in 1887).
CARLSRUHE	Central Bureau für Meteorologie und Hydrographie.	Ergebnisse der Meteorologischen Beobachtungen im Jahre 1888.
CHEMNITZ	Royal Meteorological Institute	Jahrbuch für 1887, II Hälfte, Abtheilung III, and 1888, I Hälfte, Abtheilung, II and I.
COIMBRA	Observatorio Meteorologico e Magnetico.	Observações Meteorologicas, Anno de 1888.
COLOMBO	Surveyor General of Ceylon	Administration Report, 1888, Part II, Scientific—Meteorology.

Presentations to the Library from the 1st April 1889 to the 31st March 1890—continued.

Place.	Donor.	Title of Work.
COPENHAGEN	{ Institut Meteorologique Danois . Royal Academy of Sciences .	Bulletin Meteorologique du Nord, February 1889 to January 1890. Oversigt, Nos. 3 of 1888 and 1 and 2 of 1889.
CORDOBA	{ Meteorological Office . National Academy of Sciences	Ligeros apuntes sobre el clima de la Republica Argentina. Boletin de la Academia Nacional Ciencias Tomo XI, Entrega 3a.
COSTA RICA	. Instituto Meteorologico Nacional.	Boletin, Trimestral, No. 4, October to December 1888.
DEHRA DUN	. Trigonometrical Branch, Survey of India.	Spirit levelled heights, No. 4, Madras Presidency, Season 1887-88.
DORPAT	. Observatory . . .	{ Observations, September 1888 to May 1889. Bericht über die Ergebnisse der Beobachtungen an den Regenstation für das Jahr 1887.
DUBLIN	. Royal Dublin Society . .	{ Scientific Proceedings, Volume VI, New Series, Parts 3 to 6. Scientific Transactions, Volume IV, Series II, Nos. 2 to 5.
EDINBURGH	. Scottish Meteorological Society.	Journal, third series, Nos. 5 and 6.
HAMBURGH	. Deutsche Seewarte . .	{ Aus dem Archiv der Deutschen Seewarte, VIII to XI, Jahrgang 1885 to 1888. Monatsbericht, September 1888 to October 1889. Die Ergebnisse der Wetterprognosen im Jahre 1888. Deutsche überseeische Meteorologische Beobachtungen Heft II. Ergebnisse der Meteorologischen Beobachtungen in Deutschland Jahr 1887. Wetterbericht, 1st March 1889 to 28th February 1890. Ergebnisse der Meteorologischen Beobachtungen im systeme der Deutschen Seewarte für die Lustren, 1876-1880 und 1881-1885 sowie das Dezennium, 1876-1885. Berichterstattung von Lootsen-Kommandeuren, Hafenmeistern, Vordanden von Signalstellen, etc., über die Wirksamkeit des Sturmwarnungswesens an der Deutschen Küste.
HAVANNA	. Observatorio del Real Colegio de Belen.	Observaciones Magnéticas y Meteorológicas for January to December 1887.
HONGKONG	. Observatory . . .	Observations made at the Hongkong Observatory in the year 1888.
HYDERABAD	. Secretary for Berar to the Resident.	Administration Reports of the Hyderabad Assigned Districts for 1869-70, 1870-71, 1873-74, and 1875-76 to 1887-88.
IOWA	. Dr. Gustavas Henrichs . .	Iowa Weather Report for 1880, 1884, 1885 and 1887, and the yearly numbers of 1878, 1879, 1882 and 1883.
JEYPORE	. Maharajah's Observatory	Annual Reports of the Jeypore Medical and Meteorological Institutions for 1888 and 1889.
LAHORE	{ Government of the Punjab Meteorological Office .	. Karnal Settlement Report and maps. Monthly summary of Meteorological conditions prevailing over the Punjab for April 1889 to January 1890.
LEIPZIG	. Vereins für Erdkunde . .	. Mittheilungen des Vereins für Erdkunde zu Leipzig, 1888.
LISBON	. Observatorio do Infante D. Luiz.	{ Annaes do Observatorio do Infante D. Luiz Volumes XXIII and XXIV. Annaes do Observatorio do Infante D. Luiz, observacoes dos postos Meteorologicas, segundo o plano adoptado no Congresso de Vienna, 1883 to 1885.

Presentations to the Library from the 1st April 1889 to the 31st March 1890—continued.

Place.	Donor.	Title of Work.
LISBON . . .	Observatorio do Infante D. Luiz.	Humidade do ar em Lisboa, 1856-1880.
	G. J. Symons, Esq. . .	Symons's Monthly Meteorological Magazine for March 1889 to February 1890.
	Hon. R. Abercromby, F.R.M.S.	Observations on cloud movements near the equator, and on the general character of the weather in the "Doldrums."
		Weekly Weather Report, Volume VI, Nos. 1 to 52.
		Hourly Readings for 1886, Parts I to IV.
		Meteorological Observations at stations of the second order for the year 1885.
		Summary of the observations made at the stations included in the Daily and Weekly Weather Reports for January 1888 to July 1889.
		Supplement to charts showing the mean barometrical pressure over the Atlantic, Indian, and Pacific Oceans.
	Meteorological Office .	Report of the Meteorological Council to the Royal Society for the year ending 31st March 1888.
		Quarterly Weather Report, Part IV of 1879, and Part I of 1880.
LONDON . . .		Daily Weather Reports for 1st July 1888 to 30th June 1889.
		Bulletin International Bureau Central Meteorologique de France, Paris, for 1888.
		Report of the 4th Meeting of the International Meteorological Committee held at Zurich, September 1888.
		Anemograph Minro for 1883 to 1885, published by the Physical Central Observatory, St. Petersburg.
	Publishers	Westminster Review for April to December 1889.
	Royal Asiatic Society . .	Journal, Volume XX, Part IV.
	Royal Meteorological Society	Meteorological Record, Volume VIII, Nos. 31 and 32, Volume IX, Nos. 33 and 34.
		Quarterly Journal, Volume XV, Nos. 69 to 72.
	Royal Society	Proceedings, Volume XLV, Nos. 274 to 279 and Volume XLVI, Nos. 280 to 284.
	Society of Arts	Journal, Nos. 1846 and 1895 to 1946.
MADRAS . . .	Board of Revenue	Weekly Abstract of Season Reports for the weeks ending 26th October 1889 to 15th March 1890.
MADRID . . .	Observatory	Resumen de las Observaciones Meteorologicas de Provincias, 1884, 1885, 1886 and 1887.
MAGDEBURGH .	Magdeburgischen Zeitung .	Jahrbuch der Meteorologischen Beobachtungen der Wetterwarte der Magdeburgischen Zeitung Jahrgang, VII, 1888.
MANCHESTER .	Literary and Philosophical Society.	Memoirs and Proceedings, 4th Series, Volumes I and II.
MANILA . . .	Meteorological Observatory .	Curvas Meteorograficas Trazadas en conformidad con las observaciones verificadas 1885 to 1888.
MARSEILLES .	Commission Météorologique des Bouches-du-Rhône.	Bulletin Annuel de la Commission Météorologique de Département des Bouches-du-Rhône Année 1887.
MAURITIUS . .	Royal Alfred Observatory .	Annual Report of the Director of the Royal Alfred Observatory, Mauritius, for the year 1887.

Presentations to the Library from the 1st April 1889 to the 31st March 1890—continued.

Place.	Donor.	Title of Work.
MELBOURNE . . .	Observatory	Monthly Record of results of observations in meteorology, terrestrial magnetism, &c., taken at the Melbourne Observatory September 1888 to September 1889.
MEXICO . . .	Central Meteorological and Magnetical Observatory.	Boletin Mensual Vol. I, Nos. 8 to 12, and Vol. II, Nos. 1 and 2. Anales del Ministerio de Fomento, Vol. VIII.
	Sociedad Cientifica "Antonio Alzate."	Memorias de la Sociedad Cientifica "Antonio Alzate," Vol. II, No. XI and Vol. III, Nos. I and II.
MILAN	R. Osservatorio Astronomico di Brera.	Publicazioni del Reale Osservatorio di Brera in Milano, Nos. 34 and 35. Osservazioni Meteorologiche eseguite nell' anno 1888.
MONTE VIDEO . . .	Observatorio Meteorologico del Colegio Pio de Villa Colon.	Boletin Mensual, Ano II, No. I.
MONTSOURIS (PARIS)	Observatoire Municipal . . .	Annuaire de l' Observatoire Municipal de Montsouris pour l' an 1889.
MUNICH	Meteorological Central Station	Uebersicht über die Witterungsverhältnisse im Königreiche Bayern, February 1889 to January 1890. Beobachtungen der Meteorologischen stationen im Königreiche Bayern, Vol. IX, Part 4, Vol. X, Part 4, Vol. XI, Parts I to III.
	Royal Bavarian Academy of Sciences.	Das Bayerische Praecisions-Nivellement. Siebente Mitteilung von, Carl Max von Bauernfeind. Abhandlungen der Mathematisch-Physikalischen Classe der K. B. Akademie der Wissenschaften Vol. XVI, Part III. Sitzungsberichte der Mathematisch-Physikalischen classe der K. B. Akademie der Wissenschaften, 1887, Part III, and 1888, Parts I and II.
		Returns of Rail-borne Trade of the Central Provinces for the quarters ending 30th September, 31st December 1888, 31st March, 30th June, and 30th September 1889.
		Resolution on the Revenue Administration of the Central Provinces for 1887-88. Resolution on the management by Government of private estates in the Central Provinces for the revenue year 1887-88, ending the 30th September 1888.
NAGPUR	Chief Commissioner, Central Provinces.	
NEW HAVEN . . .	Prof. E. Loomis	Contributions to Meteorology, Chapter III.
	Yale University Observatory	Report of the Observatory of Yale University for 1888-89. Transactions of the Astronomical Observatory of Yale University, Volume I, Part II.
NEW YORK	Observatory	Annual Report for 1888. Abstract of Registers from self-recording instruments for January to December 1889.
OXFORD	Radcliffe Observatory	Results of meteorological observations made at the Radcliffe Observa- tory, Oxford, in the year 1885.
PARIS	Bureau Central Meteorologique de France.	Bulletin International for 1st March 1889 to 27th February 1890. Bulletin Mensuel for January 1889 to January 1890.
PHILADELPHIA . . .	Franklin Institute	Journal for March 1889 to March 1890. Climatology of Pennsylvania by Lorin Blodget.
PÓLA	Hydrographischen Ampte	Meteorologische und Magnetische Beobachtungen for February 1889 to January 1890. Jahres ubersicht der Meteorologischen und Magnetischen Beobachtun- gen für 1888.

Presentations to the Library from the 1st April 1889 to the 31st March 1890—continued.

Place.	Donor.	Title of Work.
POONA . . .	Tidal and Levelling Operations, Survey of India.	Tide Tables for the Indian Ports for the year 1889.
PRAGUE . . .	K. K. Sternwarte . . .	Magnetische und Meteorologische Beobachtungen for 1888.
PUEBLA . . .	Observatorio Meteorologico del Colegio del Estado de Puebla.	Resumen correspondiente a cada dia, January and March to December 1889. Resumen de 11 anos di Observaciones Meteorologicas en el Colegio de Estado de Puebla.
RANGOON . . .	Director of Land Records and Agriculture, Burma.	Note on the character of the season and the crops, 1888-89. Annual Report on the Chemical Laboratory for the year ending 31st August 1888. Note on the Rainfall and character of the season, 1887-88. Annual Report for 1887-88.
RIO-DE-JANEIRO . . .	Imperial Observatory . . .	Revista do Observatorio, June to August, and December 1888, and February to December 1889.
RIPOSTO . . .	Osservatorio Meteorologico del R. Istituto Nautico di Riposto.	Bollettino Mensile, February 1889 to February 1890.
ROME . . .	Ufficio Centrale Meteorologico e Geodinamico.	Bullettino Meteorico, March 1889 to February 1890. Annali dell' Ufficio Centrale Meteorologico e Geodinamico Italiana, Series II, Volume VII, Parts I to III, and Volume VIII, Parts I to IV.
ROUSDON (DEVON) . . .	C. E. Peek, Esq. . . .	Meteorological observations made at the Rousdon Observatory for 1888.
SHILLONG . . .	Chief Commissioner, Assam . . .	Annual Report of the Department of Land Records and Agriculture, Assam, for 1888-89. Annual Report on the Administration of the Land Revenue in Assam for the year 1888-89.
SIMLA . . .	Director-General of Railways . . .	Administration Report on Railways in India for 1880-81.
SINGAPORE . . .	Colonial Secretary, Straits Settlements.	Annual Report on Meteorological observations in the Straits Settlements for 1888.
STATTGART . . .	Dr. L. Meyer	Mithielungen der K. Württembergischen Meteorologischen Central Station, Jahrgang 1888.
ST. PETERSBURGH . . .	A. Schönrock Physical Central Observatory.	Zusammenfassung der resultate wiederholter vergleichungen der normalbarometer in Europa. Annalen des Physikalischen Central Observatoriums, Jahrgang 1886, Theil I; Jahrgang, 1887, Theil II. Reportorium für Meteorologie, Band X.
STONYHURST . . .	College Observatory . . .	Results of Meteorological and Magnetical Observations 1888.
SUBATHU . . .	Rev. G. T. Carruthers . . .	A formula by which the declination of the magnetic needle at Paris may be found for any year. Magnetic disturbances.
SYDNEY . . .	Dr. H. C. Russell	Proposed method of recording variations in the direction of the vertical. President's address at the first meeting of the Australasian Association for the advancement of Science. Astronomical and Meteorological workers in New South Wales, 1778 to 1860.

Presentations to the Library from the 1st April 1889 to the 31st March 1890—continued.

Place.	Donor.	Title of Work.
SYDNEY . . .	Dr. H. C. Russell . . .	On a new self-recording thermometer.
		The thunderstorm of 26th October 1888 in Sydney.
		The storm of 21st September 1888 in Sydney.
	Observatory . . .	The source of the underground water in the western districts of New South Wales.
		The daily area of rainfall in New South Wales for January 1889 to January 1890.
		Climatological charts of Australia, July and August 1889.]
SYRACUSE . . .	Publisher . . .	Results of rain, river, and evaporation observations made in New South Wales during 1888.
	Observatory . . .	Results of meteorological observations made in New South Wales during 1887.
TASMANIA . . .	Royal Society . . .	The Pastoralist for 10th May to 14th June 1889.
TIFLIS . . .	Physical Observatory . . .	Osservazioni meteorologiche, Anno XIII, Nos. 1 to 12.
		Papers and Proceedings for 1888.
		Meteorologische Beobachtungen im Jahre 1886 and 1887-88.
		Magnetische Beobachtungen im Jahre 1886-87.
TOKIO . . .	Imperial Meteorological Central Observatory.	Report of the meteorological observations in the empire of Japan for the years 1884 and 1885.
		Annual Meteorological Report, Part I of 1886 and Part I of 1887.
		Monthly summaries and means for the year 1885 with 42 maps.
		Report of the meteorological observations taken at Kagoshima, Miyasaki, Kochi, Wakayama, Oita, Hiroshima, Osaka, Kyoto, Nagasaki, Akamagasaki, Sakai, Gifu, Hamamaten, Numzu, Tokio, Choshi, Kanazawa, Fushiki, Niigata, Akita, Ishinomaki, Miyako, Aomori, Hakodate, Suttso, Sapporo, Erimo, Soya, and Nemuro for January to December 1888; Itsugahara for April to December 1888, and Kamikawa for July to December 1888.
		Monthly Weather Review, December 1888 to December 1889.
TORONTO . . .	Meteorological Office . . .	General Meteorological Register, Toronto, 1887 and 1888.
		Report of the Meteorological Service of the Dominion of Canada for the year ending December 31st, 1886.
TRIESTE . . .	Osservatorio Marittimo dell' I. R. Accademia di Nautica.	Reporto Annuale, 1889.
TURIN . . .	Societa Meteorologica Italiana	Bolletino Mensuale dell' Osservatorio del R. Collegio Carlo Alberto in Moncalieri, Series II, Volume IX, Nos. 3 to 12, and Volume X, No. 1.
		Appunti delle stazioni, February and March 1888.
		Annuario Meteorologico Italiano, Anno V, 1890.
		P. F. Denza, I Terremoti di Novembre e di Dicembre 1887 in Italia.
		I Primi Cultori Italiani dell'aeronautica.
UPSALA . . .	Meteorological Observatory . . .	Le Valanghe degli inverni 1885 e 1888.
		La Inclinazione Magnetica a Torino e nei Dintorni.
		Bulletin Mensuel, Vol. XX, Année, 1888.

Presentations to the Library from the 1st April 1889 to the 31st March 1890—continued.

Place.	Donor.	Title of Work.
UTRECHT	Royal Dutch Meteorological Institute.	Waarnemingen in den Indischen Oceaan over de Maanden, December Januari en Februari.
		Stroomen en Temperatuur aan de Opperlakte in de Golf van Aden en den Indischen Oceaan bij Kaap Guardafui.
		Nederlandsch Meteorologisch Jaarboek voor 1879, and voor 1888.
		Wetterbericht, 1st January 1889 to 31st January 1890.
VIENNA	K. K. Central-Anstalt für Meteorologie und Erdmagnetismus.	Jahrbucher, Jahrgang 1886, Band XXIII.
	K. K. Geologische Reichsanstalt	Verhandlungen, Nos. 3 to 18 of 1889 and Nos. 1 and 2 of 1890.
		Dr. <i>Ad. Schmidt</i> .—Der tägliche Gang der erdmagnetischen Kraft in Wein und Batavia in seiner Beziehung Zum Fleckenzustand der Sonne.
		Prof. <i>G. V. Niessl</i> .—Bahnbestimmung des meteors Vom 23, October 1887.
		Dr. <i>J. Holetschek</i> .—Bahnbestimmung des Planeten (118) Peitho III Theil.
		<i>Philipp Broch</i> .—Bahnbestimmung des Kometen 1867 III.
		<i>Alois Palisa</i> .—Bestimmung der Bahn des Planeten (211) Isolda.
		<i>F. Exner</i> und <i>J. Tuma</i> .—Studien zur chemischen Theorie des galvanischen Elementes.
		Dr. <i>I. Klemencic</i> .—Untersuchungen über die Eignung des Platin-Iridiumdrahtes und einiger anderer Legirungen zur Anfertigung von Normal-Widerstandseinheiten.
		<i>G. H. Boehmer</i> .—Elektrische Erscheinungen in den "Rocky Mountains."
		<i>G. Faumann</i> .—Einfluss rascher Potentialänderungen auf den Entladungsvorgang.
		Dr. <i>J. M. Pernter</i> .—Scintillometer-Beobachtungen auf dem Hohen Sonnblick (3095 m) im Februar 1888.
	Royal Academy of Sciences	Dr. <i>J. M. Pernter</i> .—Messungen der Ausstrahlung auf dem Hohen Sonnblick im Februar 1888.
		Dr. <i>A. Grünwald</i> .—Spectralanalyse des Kadmiums.
		Dr. <i>O. Tumlirs</i> .—Berechnung des mechanischen Lichtäquivalents aus den Versuchen des Herrn Julius Thomsen.
		Dr. <i>Carl Exner</i> .—Über ein Scintillometer.
		Dr. <i>E. Freiherrn Von Haerdll</i> .—Die Bahn des Periodischen Kometen Winnecke in den Jahren 1858-1886, nebst einer neuen Bestimmung der Jupitersmasse.
		<i>J. Hann</i> .—Untersuchungen über die Tägliche Oscillation des Barometers.
		<i>E. Mach</i> .—Über die Fortpflanzungsgeschwindigkeit des durch scharfe Schüsse erregten Schalles.
		<i>E. Mach</i> und <i>P. Salcher</i> .—Über die in Pola und Meppen angestellten ballistisch-photographischen Versuche.
		<i>J. Lisnar</i> .—Die 26 tägige Periode des Nordlichtes.
		<i>M. Margules</i> .—Über die specifische Wärme comprimierter Kohlensäure.
		<i>K. Exner</i> .—Über eine Consequenz des Fresnel-Huyghens'schen Principes.

Presentations to the Library from the 1st April 1889 to the 31st March 1890—continued.

Place.	Donor.	Title of Work.
VIENNA— <i>contd.</i>	Royal Academy of Sciences .	<i>F. Lippich.</i> —Über die Bestimmung von magnetischen Momenten, Horizontalintensitäten und Stromstärken nach absolutem Masse.
		<i>W. Müller-Ersbach.</i> —Das Gesetz der Abnahme der Adsorptionskraft bei zunehmender Dicke der adsorbirten Schichten.
		<i>F. Bidschop.</i> —Bestimmung der Bahn des Planeten (175) Andromache.
		<i>§. Stefan.</i> —Über einige Probleme der Theorie der Wärmeleitung.
		Prof. <i>P. Salcher</i> und <i>§. Whitehead.</i> —Über den Ausfluss stark verdichteter Luft.
		<i>Hugo Kohler.</i> —Über den Durchgang von Elektrizität durch sehr schlechte Leiter.
		<i>K. Fuchs.</i> —Über die Oberflächenspannung einer Flüssigkeit mit kugelförmiger Oberfläche.
VIZAGAPATAM .	A. V. Nursingrow, Esq. .	<i>Dr. Konrad Natterer.</i> —Einige Beobachtungen über den Durchgang der Elektrizität durch Gase und Dämpfe.
		<i>C. Puschl.</i> —Über die specifische Wärme und die inneren Kräfte der Flüssigkeiten.
		Results of the Meteorological Observations recorded at G. V. Juggarow's Observatory, Vizagapatam during 1888.
		An extract of the list of books on Climatology and Meteorology, published by the Surgeon General of the United States Army.
WASHINGTON .	Chief Signal Office .	Bibliography of Meteorology, Parts I and II.
		Lady Franklin Bay Expedition Report, Volumes I and II.
		Monthly Weather Review of the United States for December 1888 to December 1889.
		Professional Papers of the Signal Service, Nos. VII and XVI.
		Report of the Chief Signal Officer, War Department for 1885, Part I I, 1887, Part II, and 1888.
		Report of the Chief Signal Officer of the Army to the Secretary of War for the year 1889.
		Supplement to Weather Chart of United States of America for July to December 1888.
		Tri-daily Weather Charts of the Signal Service for April to June 1888.
		Weather Charts of the United States for 8 A.M. and 8 P.M., for February 1889 to January 1890.
		Pilot Chart of the North Atlantic Ocean for March 1889 to March 1890.
		Report of Ice and Ice movements in the Bering Sea and the Arctic Basin.
		Report of the Secretary of the Smithsonian Institution for the years 1866 to 1872, and 1874 to 1876.
WELLINGTON .	Colonial Museum and Geological Survey of New Zealand }	Bulletin of the United States Geological Survey, Nos. 48 to 53.
		Monograph of the United States Geological Survey, Volume XIII with Atlas, and Volume XIV.
		Sixth Annual Report of the United States Geological Survey, 1884-85.
		Phormium Tenax by Dr. Hector.
		Progress of Geological Survey of New Zealand for 1887-88.

Presentations to the Library from the 1st April 1889 to the 31st March 1890—concluded.

Place.	Donor.	Title of Work.
WELLINGTON . . .	Colonial Museum and Geological Survey of New Zealand.	Twenty-third Annual Report of the Colonial Museum and Laboratory for 1887-88. Meteorological Report for 1885 including returns for 1883 and 1884 and averages for previous years. Statistics of New Zealand, 1888, Meteorology.
ZI-KA-WEI . . .	Observatory	Bulletin Mensuel, March 1888 to September 1889.
ZURICH	Swiss Meteorological Institute .	Meteorologische Beobachtungen, July 1888 to June 1889.

Purchases for the Library.

- American Journal of Science, March to December 1889.
 American Meteorological Journal, February to September 1889.
 American Weather. Brigadier-General A. W. Greely.
 Annalen der Physik und Chemie, Nos. 4 to 12 of 1889; Nos. 1 and 2 of 1890.
 Annandale's Concise English Dictionary.
 Beeton's Dictionary of Science.
 British Journal, Photographic Almanac, and Photographer's daily companion for 1889 and 1890. J. T. Taylor.
 Carteés Synoptiques Journalières du Temps embrassant le Nord de l'Atlantique et une partie des continents avoisinants
 publiés par l'Institut Meteorologique Danois et le Deutsche Seewarte, December 1884 to May 1886.
 Collection de Memoires relatifs a la Physique, publiés par la Societe Françoise de Physique, Volumes I to III.
 Comptes Rendus de l'Academie des Sciences, Volume CVIII, Nos. 9 to 25; Volume CIX, Nos. 1 to 27; Volume CX,
 Nos. 1 to 7.
 Constitution de L'Espace Celeste. G. A. Hirn.
 Cours de Calcul Infinitesimal, Volumes I to IV. J. Höüel.
 Cours d'Analyse de l'Ecole Polytechnique, Volumes I and II, Ch. Sturm, Volumes I to III. Jordan.
 Cours de Geometrie Descriptive de l'Ecole Polytechnique. A. Mannheim.
 Deschanel's Natural Philosophy.
 Deutsche Rundschau für Geographie und Statistik, Volume XI, Nos. 7 to 12; Volume XII, No. 1.
 Elementary Treatise on Heat. Balfour Stewart.
 Family Medicine for India. Moore.
 General Astronomy. Young.
 Joseph Von Fraunhofer's Gesammelte Schriften.
 La Nature, Nos. 824 to 874.
 La Photogravure Facile. J. Ferret.
 Mission Scientifique du Cap Horn, 1882-1883, Volume II, Meteorologie. J. Lephay.
 Nature, Nos. 1011 to 1062.
 Philosophical Magazine and Journal of Science, April 1889 to March 1890.
 Popular Lectures and Addresses, Volume I. Sir W. Thomson.
 Popular Treatise on the Winds. W. Ferrel.
 Practical Guide to the climates and weather of India, Ceylon, and Burma and the storms of the Indian Seas. H. F.
 Blanford, F.R.S.
 Report of the British Association for the advancement of Science for 1888.
 Thacker's Indian Directory for 1890.
 The Sun. Young.
 Treatise on Electricity and Magnetism, Volumes I and II. E. A. Mascart and J. Joubert.
 Treatise on Photography. Abney.
 Untersuchungen über Dämmerungserscheinungen. J. Kiessling.
 Year Book of Photography and Photographic News Almanac for 1889 and 1890. T. Bolas.

APPENDIX B.

List of Recipients of the Publications of the Meteorological Office.

Adelaide	Meteorological Observatory.
Agra	Editor of the <i>Delhi Gazette</i> .
Akyab	Port Officer.
Algeria	Meteorological Service of the Ecole des Sciences d' Alger.
	Secretary to the Government, North-Western Provinces and Oudh.
Allahabad	Meteorological Reporter, ditto ditto.
	Sanitary Commissioner, ditto ditto.
	Editor of the <i>Pioneer</i> .
Amraoti	Commissioner, Hyderabad Assigned Districts.
	Sanitary Commissioner for Berar.
Amsterdam	Royal Academy of Sciences.
Bangalore	Inspector-General of Forests, Mysore.
	Resident in Mysore.
Bassein	Port Officer.
Batavia	Magnetical and Meteorological Observatory.
Berlin	Geographical Society.
	Royal Prussian Meteorological Institute.
	Secretary to the Government of Bombay.
	Meteorological Reporter for Western India.
	Colaba Observatory.
	Sanitary Commissioner with the Government of Bombay.
	Bombay University.
	Asiatic Society of Bombay.
Bombay	Sassoon Mechanics Institute.
	Coimbra Observatory (through Consul-General for Portugal in British India).
	Editor of the <i>Bombay Gazette</i> .
	Ditto <i>Times of India</i> .
	Port Officer.
	Director of the Indian Marine.
	Secretary to the Government of Bombay, Marine Department.
Bolarum	Superintending Engineer, Hyderabad Public Works Department.
Brisbane, Queensland	Government Meteorologist.
Brussels	Royal Academy of Sciences.
	Royal Observatory.
Bucharest, Roumania	Meteorological Institute.
Budapesth	Observatory.
Cairo	Services Sanitaires et d' Hygiene Publique.
Cachar	Deputy Commissioner.
	Private Secretary to His Excellency the Viceroy.
	Secretary to the Government of India, Revenue and Agricultural Department.
	Ditto ditto Home Department.
	Ditto ditto Public Works Department.
	Ditto ditto Department of Finance and Commerce.
	Ditto ditto Military Department.
	Secretary to the Government of Bengal, Revenue Department.
	Meteorological Reporter to the Government of Bengal.
Calcutta	Surveyor-General of India.
	Geological Survey of India.
	Sanitary Commissioner with the Government of India.
	Ditto to the Government of Bengal.
	Superintendent, Botanical Gardens.
	Asiatic Society of Bengal.
	Indian Museum.
	Calcutta University.
	Presidency College.
	Public Library.

List of Recipients of the Publications of the Meteorological Office—continued.

	Editor of the <i>Statesman and Friend of India</i> .
	Ditto <i>Englishman</i> .
	Ditto <i>Indian Daily News</i> .
	Ditto <i>Hindu Patriot</i> .
	Ditto <i>Indian Engineering</i> .
Calcutta— <i>contd.</i>	St. Xavier's College Observatory.
	Alipore Observatory.
	Mint Master.
	Indian Association for the Cultivation of Science.
	Port Officer.
	Deputy Conservator, Port Approaches.
Cambridge	University Library (through H. M.'s Secretary of State for India).
Cambridge, Massachusetts	Harvard College Library.
Cape of Good Hope	Astronomer Royal.
Carlsruhe, Baden, Germany	Bureau für Meteorologie und Hydrographie.
Cawnpore	Director of Land Records and Agriculture, North-Western Provinces and Oudh.
Chandbali	Port Officer.
Chatham	Royal Engineer's Library.
Chemnitz	Royal Meteorological Institute.
Chittagong	Port Officer.
Christiania	Norske Meteorologiske Institut.
	Royal Observatory.
Colombo	Editor of the <i>Ceylon Times</i> .
	Ditto <i>Ceylon Observer</i> .
	Surveyor-General of Ceylon.
Copenhagen	Danske Meteorologiske Institut.
	Royal Danish Academy of Sciences.
	Meteorological Office.
Cordoba	National Academy of Science.
	Servicio Meteorologico de la Provincia de Cordoba.
Dacca	Dacca College.
Darjeeling	Conservator of Forests, Bengal.
	Editor of the <i>Indian Forester</i> .
Dehra Dun	Superintendent, Great Trigonometrical Survey.
	Forest School.
Dublin	Royal Dublin Society.
Dibrugarh	Deputy Commissioner, Lakhimpur.
	Scottish Meteorological Society.
Edinburgh	Astronomer Royal for Scotland.
	Scottish Geographical Society (through H. M.'s Secretary of State for India).
False Point	Port Officer.
Florence	R. Biblioteca Nazionale Centrale di Firenze.
Folkestone	H. F. Blanford, Esq., F.R.S.
Greenwich	Astronomer Royal, Royal Observatory.
Goa	Meteorological Observatory.
Goalpara	Deputy Commissioner.
Gauhati	Ditto ditto, Kamrup.
	Commissioner, Assam Valley Districts.
Giessen	Oberhessische Gesellschaft für Natur und Heilkunde.
Hamburgh	Deutsche Seewarte.
	Deutsche Meteorologische Gesellschaft.
Havana	Real Colegio de Belen.
Hong-Kong	Observatory.
Hyderabad	Conservator of Forests, Sind Circle.
Indore	Agent to the Governor General for Central India.
Iowa, U. S.	Dr. Gustavus Heinrichs.
Jeypore	Maharajah's Observatory.
Jubbulpore	Civil Surgeon.
Katmandu	Resident at Nepal.
Khandwa	Civil Surgeon of Nimar.
Kohima	Deputy Commissioner, Naga Hills.
Kew	Observatory.
Kidderpore	Deputy Director, Indian Marine.

List of Recipients of the Publications of the Meteorological Office—continued.

Lahore	{	Secretary to the Government of the Punjab.
		Sanitary Commissioner ditto ditto.
		Conservator of Forests, Punjab.
		Meteorological Observatory.
Leeds . . . . .	.	Yorkshire College (through H. M.'s Secretary of State for India).
Leipzig . . . . .	.	Geographical Society.
Lisbon	{	Observatorio de Infante d'Luiz.
		Academy of Science.
London	{	Her Majesty's Secretary of State for India.
		Meteorological Council.
		Royal Society.
		Royal Asiatic Society (through H. M.'s Secretary of State for India).
		Northbrook India Club (ditto ditto ditto).
		Society of Arts.
		Institution of Civil Engineers.
		Royal School of Mines.
		Royal Meteorological Society.
		Admiralty Library.
		United Service Institution.
		British Museum (through H. M.'s Secretary of State for India).
		Editor of the <i>Philosophical Magazine</i> .
		Ditto <i>Athenæum</i> .
		Ditto <i>Nature</i> .
Madras	{	Ditto <i>Symons's Monthly Meteorological Magazine</i> .
		Ditto <i>Westminster Review</i> .
		Organizing Committee of the Imperial Institution of the United Kingdom, the Colonies, and India.
		Secretary to the Government of Madras.
		Ditto ditto, Public Works Department.
		Meteorological Reporter to the Government of Madras.
		Government Astronomer, Madras.
		Sanitary Commissioner, ditto.
		Madras University.
		Editor of the <i>Madras Times</i> .
Madrid	{	Ditto <i>Madras Mail</i> .
		Ditto <i>Christian College Magazine</i> .
		Government Central Museum.
		Assistant Director of Land Records and Agriculture, Government of Madras.
		Surgeon-General, H. M.'s British Forces.
		Ditto, with the Government of Madras.
		Presidency Port Officer.
		Conservator of Forests, Northern Circle.
		Ditto ditto Southern Circle.
		Revenue Survey Department.
Magdeburg . . . . .	.	Royal Observatory.
Manchester . . . . .	.	Observatory of the Magdeburg Zeitung.
Manila . . . . .	.	Literary and Philosophical Society.
Mauritius . . . . .	.	Meteorological Observatory.
Melbourne, Victoria	{	Meteorological Society.
		Observatory.
		University Library.
Mexico . . . . .	.	Public Library.
Milan . . . . .	.	Central Meteorological Observatory.
Mount Abu	{	Royal Astronomical Observatory.
		Governor-General's Agent in Rajputana and Chief Commissioner of Ajmere-Merwara.
		Secretary to the ditto ditto ditto ditto P. W. D.
Monte Video . . . . .	.	Meteorological Central Observatory.
Moulmein . . . . .	.	Port Officer.
Munich	{	Royal Observatory.
		Royal Academy of Sciences.
		Geographical Society.
		Royal Meteorological Central Station.

List of Recipients of the Publications of the Meteorological Office—continued.

Nagpur	Chief Commissioner, Central Provinces.
	Sanitary Commissioner, ditto.
	Inspector-General of Education, ditto.
	Meteorological Observatory.
Naini-Tal	Conservator of Forests, Central Provinces.
	Ditto ditto Central Circle, North-Western Provinces and Oudh.
New Haven, Connecticut	Academy of Arts and Sciences.
New York, U. S.	Editor of the <i>American Journal of Science</i> .
Nowgong (Assam)	Meteorological Observatory.
Oxford	Deputy Commissioner.
	Radcliffe Library.
	Radcliffe Observatory.
	Observatoire Municipal de Montsouris.
Paris	Editor of <i>La Nature</i> .
	Physical Observatory, Meudon.
	Bureau Central Météorologique de France.
	Meteorological Society of France.
Perpignan, France	Observatoire Météorologique et Magnétique.
Perth, W. Australia	Meteorological Reporter.
Pesaro, Italy	Magnetical and Meteorological Observatory.
Philadelphia	Franklin Institute.
Poona	Conservator of Forests, Northern Circle, Bombay Presidency
Prague, Bohemia	K. K. Sternwarte.
Puebla	Colegio del Estado de Puebla.
Quebec	Literary and Historical Society.
Raipur	Civil Surgeon.
Rangoon	Chief Commissioner, Burma.
	Sanitary Commissioner, ditto.
	Conservator of Forests, Pegu Circle.
	Editor of the <i>Rangoon Times</i> .
	Chamber of Commerce, Burma.
	Port Commissioners.
	Port Officer.
Rome	Agricultural and Horticultural Society.
	Central Meteorological Office.
Rio de Janeiro	Imperial Observatory.
Saharanpur	Superintendent, Botanical Gardens.
Santiago	Observatorio Nacional.
Sibsagar	Deputy Commissioner.
Sylhet	Ditto ditto.
Shillong	Secretary to the Chief Commissioner of Assam.
	Ditto ditto ditto Public Works Department.
	Conservator of Forests, Assam.
	Deputy Commissioner, Khasi and Jaintia Hills.
	Director of Land Records and Agriculture.
Simla	Sanitary Commissioner.
	Assistant Quarter Master General, Intelligence Branch.
Singapur	Principal Civil Medical Officer, Straits Settlements.
Stockholm	Nautisk Meteorologiska Byrån.
St. Petersburg	Physical Central Observatory.
	Imperial Geographical Society of Russia.
	Prof. H. Wld, Physical Central Observatory.
Strasburg	Imperial University Library.
Sydney	Observatory.
	University Library.
Syracuse, Sicily	Royal Meteorological Observatory.
Tasmania	Royal Society.
Tiflis, Russia	Physical Observatory.
Tokio, Japan	Imperial Mining Office.
Toronto, Canada	Meteorological Central Observatory.
	Meteorological Office.
Turin	Royal Astronomical Observatory.
	Meteorological Society of Italy.

List of Recipients of the Publications of the Meteorological Office—concluded.

Tura	Deputy Commissioner, Garo Hills.
Tezpur	Ditto Darrang.
Upsala	Meteorological Observatory.
Utrecht	Royal Netherlands Meteorological Institute.
	K. K. Central-Anstalt für Meteorologie und Erdmagnetismus.
Vienna	K. K. Geologische Reichsanstalt.
	Imperial Academy of Sciences.
	Dr. J. Hann.
Vizagapatam	A. V. Nursingrow, Esq.
	Chief Signal Officer, United States Army.
	Smithsonian Institution.
Washington, U. S.	United States Naval Observatory.
	Hydrographic Office.
	Prof. Cleveland Abbe.
	United States Geological Survey.
Wellington, New Zealand	Colonial Museum.
Whalle (England)	Stonyhurst College Observatory.
Woolwich	Royal Artillery Library.
Zi-ka-wei, Shanghai	Magnetical and Meteorological Observatory.
Zurich	Central Meteorological Office.

REPORT
ON
THE ADMINISTRATION
OF THE
METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA
IN
1890-91.

PART I.—GENERAL.

The present Administration Report is divided into two parts. The first gives a general account of the results of the more important sections of the work of the Department during the past year. The second part gives the usual details of administration, chiefly in the form of tables. In accordance with instructions given in the orders on the Administration Report for the previous year, the present Administration Report has been made as brief as is consistent with giving an intelligible statement of the work of the Department during the past year.

2. The Meteorological Department of the North-Western Provinces sustained during the year a most serious loss in the death of its Chief Officer, Mr. S. A. Hill. He returned from furlough in December 1889, and assisted materially during the next few months in carrying out the various measures that were in progress for the improvement of the Meteorological Department. He died on the 23rd September 1890, after a few days' illness.

3. He was appointed Meteorological Reporter to the Government of the North-Western Provinces in March 1876. During the fifteen years that he was Reporter, he not merely carried out the ordinary duties of the appointment, but wrote and published a large number of papers containing meteorological investigations, many of them of great value for their originality and suggestiveness as well as for the importance of the meteorological principles established in them. The following were the more important papers he contributed to the Indian Meteorological Memoirs:—

- (1) On the rainfall of Benares, considered in relation to the prevailing winds.
- (2) Some results of the meteorological observations taken at Allahabad during the ten years 1870-79.

- (3) The meteorology of the North-West Himalayas.
- (4) Variations of rainfall in Northern India.
- (5) On observations of temperature and humidity at a height of 40 feet above the ground at Alipore Observatory, Calcutta.
- (6) On the temperature of North-Western India.
- (7) On the ground temperature observations made at the old observatory, Allahabad.
- (8) On temperature and humidity observations made at Allahabad at various heights above the ground.

4. He also prepared several valuable meteorological sections for the Provincial Gazetteer in course of publication, and contributed numerous papers to the Transactions of the Royal Society and the chief European meteorological journals.

5. He was a most zealous worker in the field of Indian meteorology, and his wide scientific knowledge, habits of patient and thorough research, specially qualified him to work out the more difficult problems which it presents, and his loss is consequently a most serious one to the Department.

OBSERVATORIES.

6. The number of observatories under the control of the Meteorological Department maintained by the Government of India at the beginning of the year was distributed as follows:—

First class	.	.	.	.	4
Second class	.	.	.	.	53
Third class	.	.	.	.	102

7. The observatory at Paumben, sanctioned in the previous year, commenced work from 2nd January 1891.

8. Voluntary observatories were sanctioned or established during the year at Mardan, Fort Tregear and Kalimpong. The establishment of an observatory at Mardan, the most northerly military station in the Punjab, was suggested by the local military authorities, and will be, when opened, placed under the control of the Medical Officer in charge of that station. The observatory at Fort Tregear in the Chittagong Hill Tracts was started by the Medical Officer in charge of that military station. The observatory at Kalimpong in the Darjeeling district is at an elevation of about 3,930 feet in a very open position and promises to give very reliable observations. It is established at the Scotch Mission and is under the supervision of the Revd. Mr. Sutherland, the Head of the Mission.

9. Advantage was taken of the establishment of a tidal observatory at the Island of Minicoy, off the Malabar Coast, to open a second-class meteorological observatory in connection with it. The tidal observer is allowed to act as meteorological observer, and records observations at 8, 10 and 16 hours. The observatory commenced work in the last week of January 1891, and several valuable series of observations have already been received. The establishment of this observatory was due to the suggestion and assistance of Colonel Strahan, in charge of the tidal observations. It will probably give accurate and useful information respecting the origin and character of those cyclones in the Arabian Sea which form near the Laccadive Islands.

10. Arrangements were completed in April 1891 for re-opening the observatory at Camorta (Nancowry) in the Nicobars, and instruments were sent to the Superintendent of Port Blair to be forwarded at the first opportunity. No observations have as yet been received under the new arrangement.

11. The observatory at Zanzibar was closed during the year. No observations were received from the Seychelles, and, so far as I have been able to ascertain, Dr. Meldrum, Director of the Mauritius Meteorological Service, has not yet been able to arrange for the establishment of an observatory there.

12. The extra-Indian observatories at Bushire and Aden contributed useful and accurate series of observations during the year. The observations taken at Meshed by Dr. Woolbert, Medical Officer attached to the Military Officer on special duty on the Perso-Afghan Frontier, have been very interesting, as showing an intimate connection between the weather in Northern India and the whole of Afghanistan and Eastern Persia and probably Turkestan during the winter of 1890-91.

13. The observations taken at Baghdad were even less satisfactory than usual. There is much difficulty in ascertaining and correcting errors in the methods of observation at these distant stations. No observations have been obtained from Amini Devi during the past year, in consequence of the observer having been transferred. Arrangements are in progress for supplying another observer to this out-of-the way station.

14. Very satisfactory progress has been made during the past year in the direction of establishing observatories in three of the largest Native States in India. Chiefly through the influence of Mr. Lawrence, Settlement Officer, Kashmir, the Kashmir Durbar has sanctioned the establishment of an observatory at Srinagar. The observatory will be maintained at the cost of the Kashmir State, and the instruments and forms, &c., supplied by the Meteorological Department. The chief observer of the Lahore observatory has been deputed to proceed to Srinagar with the instruments and assist in training the observer and opening the observatory.

15. During my cold-weather tour I visited Hyderabad with the object of pointing out to the Nizam's Government the desirability of additional observatories in that part of the Deccan. Hitherto the only observatory in the Hyderabad State was that at Secunderabad maintained by the Government of India. The Nizam's Government responded most liberally to my suggestion, and offered to establish seven observatories during the present year to work in co-operation with the India Meteorological Department, provided the instruments were supplied by the Department and an officer was sent to train the observers who will be selected and paid by the Nizam's Government. The observatories are in course of erection, and will probably commence work in the month of August or September. The seven stations selected for the establishment of these observatories are:—

Hyderabad.	Aurangabad.
Gulburga.	Khammamett.
Raichore.	Indore.
Bidár.	

16. The establishment of these seven observatories will fill up a gap in an important portion of the Indian area which has hitherto been very imperfectly represented by the one station of Secunderabad.

17. I also visited Bangalore, and found that the Government of Mysore would probably

be equally ready to establish a series of observatories. The only observatory in that State is at Bangalore, and is maintained by the Government of India. The selection of stations and the conditions of the establishment of the observatories in that State are still under consideration, but I hope to be able to state in next year's Administration Report that three or four observatories have been established in Mysore under the same conditions as in the Hyderabad and Kashmir States.

18. In order to elucidate the origin and character of the cold-weather cyclonic storms of Northern India, to which the snowfall of the Western Himalayas and mountain ranges to the north-west of the Punjab is mainly due, meteorological data from Afghanistan and Persia are urgently required. Three or four lines of stations across these countries would, in the course of two or three years, decide the question whether these storms originate in Upper India and the mountain districts to the west of the Punjab, or advance across Persia from Southern Europe or elsewhere, and also throw much light on the phenomena of these storms and the source and distribution of the accompanying rainfall.

19. The Indian Telegraph Department has offered to give every assistance towards the establishment of observatories at Teheran, Ispahan, Gwadar, Jask, and other telegraph stations on the line of the Indo-European Telegraph Department. It will be necessary to send an officer with the instruments to see that they receive as little injury as possible during their transit in Persia. He will train the Telegraph Masters to read the instruments and assist, so far as necessary, in opening the observatories. As soon as I can arrange to depute an officer for the work, sanction will be asked for the establishment of the observatories selected for the object in view.

INSPECTION OF OBSERVATORIES.

20. A somewhat larger amount of work was done in this direction than in the previous year. The following gives a summary of the work done:—

Inspected by	Number of observatories inspected in	
	1890-91.	1889-90.
Imperial Reporter	24	29
Assistant or Provincial Reporter or Sanitary Commissioner .	21	23
Personal Assistant to the Imperial Reporter	41	23*
TOTAL .	86	75

* By Native Inspector.

21. The amount of inspection was restricted to some extent by the death of Mr. Hill, who usually did a considerable amount of inspection during the cold weather. It was also necessary for me to spend a portion of the time available for my cold-weather tour at Allahabad to make arrangements for carrying on the work of the Allahabad office until the appointment of a successor to Mr. Hill.

22. My Personal Assistant, Lala Hem Raj, was sent down to Calcutta for a short course of training at the Alipore observatory in testing and verifying barometers and thermometers

for their instrumental errors, and afterwards at the Mathematical Instrument Department in examining and repairing meteorological instruments generally. He then accompanied me on a short tour of inspection in Bengal, after which he went on a long and independent tour of inspection in Northern India in November and December, and on a second tour in Central and Western India in the months of January, February and March. He inspected in all 39 observatories, making most careful comparisons of the instruments with secondary standards, and sending very full notes of his inspection, which enabled me to ascertain the exact condition of these observatories at the time of inspection. He detected great irregularities at Durbhanga, Pachpadra and other observatories. His work of inspection was in fact most thoroughly and satisfactorily performed, and enabled me to place a number of our observatories on a much more satisfactory footing than they have hitherto been.

ACTINOMETRIC WORK.

23. The actinometric work was carried on at Simla during the past year in the same manner as in the previous year. The following is a statement of the work done during the year :—

MONTH.	SHORT RANGE SERIES (CONSISTING OF 3 SETS OF OBSERVATIONS DAILY).		LONG RANGE SERIES.	
	Complete sets of observations.	Incomplete sets of observations.	Complete sets of observations.	Incomplete sets of observations.
April 1890	4	12	1	...
May „	4	4	...	...
June „ . . . . .	...	...	...	...
July „ . . . . .	...	...	...	...
August „ . . . . .	...	...	...	...
September 1890 . . . . .	...	...	...	...
October „ . . . . .	...	...	5	...
November „	3	...	1	...
December „ . . . . .	...	...	...	...
January 1891	1	2	...	...
February „ . . . . .	...	2	...	...
March „ . . . . .	...	2	1	3

24. The winter of 1890-91 was one of the most cloudy of recent years, and hence it was not possible to do much actinometric work. It may, however, be pointed out that the number of long range series taken during the year exceeded those hitherto taken in any previous year. They are far more valuable than the short range series, and it is very creditable to the observer, Babu Nirbhai Singh, that he should have taken so many of these long range series.

25. The results of these observations have been sent, in accordance with the standing arrangements sanctioned when they were first started, to the Solar Physics Committee. I have not heard whether any use has been made of them, or whether they are satisfactory.

RAINFALL REGISTRATION.

26. The changes that were sanctioned in the previous year for the improvement of the methods of rainfall registration in India were fully stated in last year's report. They were :—

- (1st) The adoption of a common type of rain-gauge (*viz.*, Symons') for rainfall registration throughout India.
- (2nd) The supply of the instruments by the Meteorological Office, which arranges that all rain-gauges are tested before issue.
- (3rd) More frequent inspection of rain-gauge stations, and the submission of all reports of inspection to some controlling officer.
- (4th) The examination of all rainfall data for elimination of errors by duly qualified officers in different provinces, so that the rainfall data collected in different provinces of India may be fairly comparable in point of accuracy.
- (5th) The annual publication of the rainfall data of the whole of India in a complete form for the use of engineers, irrigation officers, European meteorologists, and others interested in the rainfall statistics of India.

27. Arrangements were made with the Mathematical Instrument Department for the supply of Symons's rain-gauges of the pattern adopted as required, and for the testing of all rain-gauges before issue by the Meteorological Department.

28. The Madras Government ordered the whole of the rain-gauges in previous use (which were of a different pattern) to be replaced by Symons' rain-gauges. In the North-Western Provinces the great majority of sub-divisional stations which have hitherto been supplied with Fleming's gauges will, by the action of the district officers, who are taking much interest in the improvement of rainfall registration, be furnished with Symonss' gauges during the present year.

29. Several of the Native States in Rajputana and Kashmir have also indented for additional rain-gauges to equip rainfall-registering stations. For example, Kashmir proposes to establish ten new rain-gauge stations. Hence one important effect of the unification of the system of measuring rainfall throughout India has been to increase very considerably the amount of registration in certain areas in which the work had hitherto been very imperfectly carried out, and to furnish data in future for areas for which hitherto there have been no available rainfall returns.

30. So far as can be judged from the information received in the Meteorological Office, much attention is now being paid to the inspection of rain-gauge stations. Copies of the reports of inspection which have been forwarded to the Meteorological Office show that at the majority of the rain-gauge stations the rain-gauges were in good order and the rainfall measurements properly made. Several called attention to defects in the instruments, and others to errors on the part of the rainfall observers, which were pointed out to them at the time of inspection.

31. The arrangements for the publication of the rainfall data of the whole of India are progressing satisfactorily.

32. The 1st January 1891 was selected as the date for the commencement of the publication of the monthly rainfall returns. Returns for the provinces of Bengal, the North-Western Provinces, the Punjab, Burma, the Central Provinces and Coorg have been published for the months of January, February, and March 1891. The Simla office has published in the same form the rainfall data of the Native States of Rajputana, Central India, Hyderabad, &c. There has been some delay due to various causes in the commencement of the publication of these returns for Bombay, Madras, Assam and Berar, but the returns for the first three months of each of these provinces will, I am informed, be published very shortly.

33. When the preparation and publication of these returns have been fully commenced, it will be possible, with the co-operation of the local authorities and officers controlling the rainfall registration in the various provinces, for the whole of the available rainfall data of India for any month to be available for discussion either a month or six weeks after the termination of the month to which they refer.

34. As stated in last year's report, the whole of the available rainfall records of the following provinces have been examined and tabulated into the books filed in the Meteorological Office:—

	Number of stations for which data are available.
Punjab	174
North-Western Provinces and Oudh	254
Bengal	169
Assam	69
Central Provinces	70
Bombay	67
Madras	125
Mysore	76

35. The original records of the rainfall in Berar preserved in the Deputy Commissioners' offices have been forwarded, and will be tabulated during the present year.

36. The Simla office has prepared and sent tables of monthly mean rainfall and mean number of rainy days to the officers controlling the rainfall registration in the North-Western Provinces, the Central Provinces, Assam, the Punjab and Mysore for inclusion in the columns of averages in the monthly rainfall statements published by these provinces.

37. Weekly and monthly district averages for the whole of India are also in course of calculation for use by the Simla office in the comparison of the actual rainfall of weekly and monthly periods with the normal in the weekly weather and rainfall report given in the *Gazette of India* and in the *India Monthly Weather Review*.

38. The tabulation of the available rainfall data and the calculation of average data, as originally contemplated in my letter suggesting improvements in rainfall registration will hence be completed during this year. The whole of the rainfall data for the provinces in India under direct British rule up to the present date will then have been tabulated and filed for any future reference.

STORM OBSERVATIONS.

39. A large number of special observations of storms were sent in during the year. Many of these were of little value, except for indicating the exact time and direction of the registered storm. The great majority were observations of the various classes of storms of the hot weather, or of thunderstorms, hail-storms, and dust-storms, and will be of considerable use in discussing at any future time the time of occurrence and distribution and character of this class of storms. A very small proportion furnished information respecting cyclonic storms of the south-west monsoon, but this was chiefly due to the unusually small number of these storms during the year.

40. Some of the series gave very complete and valuable information of the storms they dealt with, and show accurate and intelligent observations on the part of the observers. 350 sets of observations in all were sent in by observers. Special amounts varying from R1 to R60 were awarded to these observers.

MARINE METEOROLOGY.

41. A large amount of work has been done under this head. Two clerks of the Calcutta office were almost constantly engaged during the year in collecting meteorological data from ships entering the Hooghly, and the amount of information was very much larger than has been obtained in any previous year. The clerks made a careful comparison of the barometers on board the ships from which they obtained information, in order to ascertain the corrections to be applied to the barometric readings extracted from the logs of the vessels.

42. The Bombay Meteorological Office collected data from vessels entering the port of Bombay by the same methods as are employed at Calcutta. One clerk was engaged almost continuously throughout the year, and the Head Clerk, Mr. Ganesh Sadashiv, also devoted any leisure time in his office hours to the same work. He was unfortunately severely injured when on this duty in February. He was struck by a bale of goods when mounting a ship's ladder, and broke his leg, and had to go to hospital for nearly two months. Notwithstanding this unfortunate accident, the Bombay office did a large amount of useful work during the year in collecting marine data.

43. The following table gives a statement of the work done under this head during the past year, and the corresponding figures of the three previous years, for comparison :—

		1890-91.	1889-90.	1888-89.	1887-88.
CALCUTTA	{ Number of logs extracted	1,294	419	338	214
	{ Number of barometric comparisons	6,094	334	P	P
BOMBAY	{ Number of logs extracted	688	535	72	94
	{ Number of barometric comparisons	1,765	420	P	P

44. The extracts were properly tabulated during the past year, and daily weather charts of the whole Indian area have been prepared for the first six months of the year

1890, and the remainder will be shortly completed. The information respecting the Arabian Sea and Bay of Bengal, which was obtained last year, was sufficient to enable fairly satisfactory weather charts to be prepared, and if arrangements can be made, it is proposed to publish the charts for the present year.

SEASONAL FORECASTS.

45. The forecast of the probable character of the rainfall during the south-west monsoon of 1890 was issued, in the same form as in the preceding two years, in the *Gazette of India* of the 7th of June 1890, under the heading of Memorandum on the snowfall in the mountain districts of Northern India and Afghanistan, and the abnormal features of the meteorology of India during the period January to May 1890.

46. These forecasts are based partly on information of the snowfall in the mountain areas to the north and north-west of Northern India, partly on the distribution of pressure in the month of May and the changes in the abnormal features of the pressure distribution that have taken place in the hot-weather months of April and May, and partly on a comparison with the meteorology of previous years. The Memorandum published in the *Gazette of India* gave a full statement of the chief data upon which the forecast was based, and it is hence not necessary to repeat it here.

47. The following gives the full statement of the forecast itself as published in this Memorandum:—

- “(1) Snowfall conditions in the Himalayas and Afghan area, and the general pressure conditions over India, are on the whole favourable to a somewhat stronger and earlier monsoon than usual.
- (2) Conditions are more favourable in Northern and Eastern India than in Western India.
- (3) In consequence of peculiar pressure conditions in the north of the Bay there may be a considerable delay in the establishment of the monsoon current over the Gangetic Valley.
- (4) The conditions are very favourable in Burmah, Assam and the greater part of Bengal, which will hence probably obtain normal or excessive rainfall.
- (5) Conditions are somewhat less favourable in the North-Western Provinces and Behar, but on the whole it is probable they will receive their normal amount.
- (6) Conditions are distinctly unfavourable in the Punjab and Rajputana, due to the peculiar pressure conditions around the Gulf of Cambay. If the Bombay current be unusually strong in consequence of conditions in the Arabian Sea area (and hence not known), these areas may receive moderate and favourable rainfall. If the Bombay current be weak, it is very probable there will be a considerable deficiency in these two areas.
- (7) The conditions are equally unfavourable in North Bombay (more especially the North Bombay Deccan) and Berar, and the rainfall in those areas will also depend largely upon the strength of the Bombay current. Judging from the present known conditions in India, there is likely to be a considerable deficiency in these areas.
- (8) Taking into consideration the pressure conditions and the probable strength and set of the Bombay current, the rainfall in the Central Provinces, so far as can be judged, will probably be normal in character, any tendency to excess being more likely in the eastern than the western districts.
- (9) In the Peninsula the pressure conditions are somewhat unfavourable for heavy rain in the districts east of the West Ghâts, which will hence probably receive somewhat less than their normal rainfall during the south-west monsoon, whilst the Coast districts south of Bombay will probably receive normal or excessive rain.

It should be noted that one of the important factors, *viz.*, the pressure conditions in the Arabian Sea, is of unusual importance this year, and hence that the inferences stated above are, more especially for North-Western India, uncertain to that extent, and with this element of doubt should be carefully kept in view.”

48. The following two tables give rainfall data of the south-west monsoon of 1890 for comparison with the forecast. The first table gives data for each of the 51 areas into which the empire is divided for the purposes of comparing crops, prices and rainfall.

The second table gives a summary of this data arranged according to the respective provinces :—

PROVINCE.	DIVISION.	RAINFALL DATA FROM MAY 27TH TO OCTOBER 13TH, 1890.		
		Average actual rainfall of season to date.	Average normal rainfall, May 27th to October 13th.	Excess or defect of (seasonal) rainfall expressed as a percentage.
		Inches.	Inches.	Per cent.
BURMA	Tenasserim	130'95	166'30	— 21
	Lower Burma	83'63	84'50	— 1
	Central Burma	60'64	67'28	— 10
	Upper Burma	22'02	P	P
	Arakan	148'04	166'49	— 11
BENGAL AND ASSAM	Eastern Bengal	69'61	75'71	— 8
	Assam (Surma)	114'17	85'11	+ 34
	Do. (Brahmaputra)	66'10	62'73	+ 5
	Deltaic Bengal	43'95	48'03	— 8
	Central Bengal	54'53	47'84	+ 14
	North Bengal	108'44	87'37	+ 24
	Orissa	56'18	47'49	+ 18
	Chota Nagpur	45'81	46'78	— 2
	Behar (South)	48'16	38'82	+ 24
	Do. (North)	59'04	44'82	+ 32
NORTH-WESTERN PROVINCES AND OUDH.	North-Western Provinces (East)	46'22	35'08	+ 32
	Oudh (South)	44'30	34'05	+ 30
	Do. (North)	54'92	36'19	+ 52
	North-Western Provinces (Central)	32'51	28'74	+ 13
	Ditto (West)	34'43	27'34	+ 26
	Ditto (Sub-montane)	52'29	39'40	+ 33
PUNJAB	Punjab (South)	10'36	12'24	— 15
	Do. (Central)	23'11	21'23	+ 9
	Do. (Submontane)	22'89	24'48	— 6
	Do. (Hill Districts)	73'25	75'33	— 3
	Do. (North-West)	21'37	18'14	+ 18
	Do. (West)	5'52	6'20	— 11
BOMBAY AND MALABAR COAST DISTRICTS (MADRAS).	Malabar	71'27	95'15	— 25
	Madras (South Central)	22'64	17'28	+ 31
	Coorg	70'64	94'15	— 25
	Mysore	13'25	20'99	— 37
	Konkan	129'24	100'48	+ 29
	Bombay Deccan	28'27	30'66	— 8
	Hyderabad (North) . . . . .	...	...	...
	Khandeish	19'75	25'77	— 23
CENTRAL PROVINCES AND BERAR.	Berar	36'02	35'23	+ 2
	Central Provinces (West)	36'34	41'48	— 12
	Ditto (Central)	54'22	48'65	+ 12
	Ditto (East)	47'27	48'05	— 2
BOMBAY (NORTH)	Guzerat	34'22	38'64	— 11
	Kattiawar	15'84	26'51	— 40
	Sind	5'71	4'33	+ 32
RAJPUTANA AND CENTRAL INDIA.	Central India (East)	35'01	35'14	0
	Rajputana (East), Central India (West)	24'78	26'35	— 6
	Rajputana (West)	13'77	12'71	+ 8
MADRAS	East Coast (North)	30'13	26'09	+ 15
	Ditto (a)	58'70	55'15	+ 6
	Hyderabad (South)	27'24	21'79	+ 25
	Madras (Central)	17'25	18'44	— 6
	East Coast (Central)	15'32	19'99	— 23
	Ditto (South)	20'14	16'75	+ 20
	Madras (South)	8'66	10'64	— 19

49. The following gives a summary of the preceding statement:—

PROVINCE.	Actual rainfall.	Average rainfall.	Percentage variation.
Burma	105'82	121'14	— 13
Assam and East Bengal	83'29	74'52	+ 12
Bengal	65'78	57'68	+ 14
Behar	53'60	41'82	+ 28
North-Western Provinces and Oudh	44'11	33'47	+ 35
Punjab	26'08	26'27	— 1
Rajputana	19'28	19'53	— 1
Central India	35'01	35'14	0
Central Provinces and Berar	43'46	43'35	0
Madras	25'35	24'12	+ 5
Bombay Deccan and Hyderabad	28'27	30'66	— 8
Bombay Coast Districts	100'26	97'82	+ 2

50. A comparison of these actual rainfall data with the forecast will show that there was a very fair accordance between the two. The chief differences appear to be between the predicted and actual rainfall in the North-Western Provinces and a portion of the Punjab. This was, however, due to the unusual strength of the Bombay current in the months of July and August, and the importance of this factor on this occasion was, it may be noted, carefully pointed out. The indications in Madras before the approach of the monsoon were not sufficiently decided to enable the deficient character of the rainfall in that area to be foreseen.

STORM WARNINGS.

51. The work of warning Indian ports of the approach of cyclonic storms or other bad weather is performed by two offices. Ports on the Bay of Bengal are warned from the Calcutta office by the Meteorological Reporter to the Government of Bengal, and ports on the Arabian Sea from the Simla office by the Meteorological Reporter or Assistant Meteorological Reporter to the Government of India.

52. *Bay of Bengal Storm Signal Service.*—The following gives a list of the ports which are warned by the Meteorological Reporter to the Government of Bengal:—

(a) *Burma Ports*—

Moulmein.
Rangoon.
Bassein.
Akyab.

(b) *Bengal Ports*—

Calcutta and River Hooghly.
Naraingunge.
Chittagong.
Orissa Ports, including Pooree,
False Point, Chandbally, and
Balasore.

(c) *Madras Ports*—

Bimlipatam.
Gopalpur.
Vizagapatam.
Cocanada.
Masulipatam.
Madras.
Negapatam.
Tuticorin.

53. A complete statement of the arrangements and methods employed for warning these ports will be found in pages 14 to 17 of the Administration Report of the year 1887-88.

54. No change was made in the methods of warning the Bay of Bengal ports, Narain-gunge was added to the list of ports to be warned. The signals selected for that port are practically identical with those used for the neighbouring port of Chittagong.

55. In connection with this work it was stated in the Administration Report of the year 1888-89 (*vide* paragraph 34) that arrangements had been made for obtaining early telegraphic information of the weather, from the Pilot Brigs at the Sandheads in the hope that this information would occasionally give earlier and more definite data of the approach of cyclonic storms to the north-west angle of the Bay, the most dangerous portion of that sea area. Mr. Pedler, Meteorological Reporter to the Government of Bengal, states that the system devised worked very satisfactorily during the past year. The Telegraphic Code prepared for the purpose proved very successful, and an average number of about 16 telegrams were received monthly during the past year.

56. It has been mentioned in the past annual reports that during stormy weather the telephonic communication with False Point observatory generally broke down at the commencement of each storm, and that this station was thus frequently unable to send observations at the time when they were most urgently required for forecasting the weather in the northern part of the Bay. At the instance of the Government of Bengal, the telephone office at False Point was converted into an ordinary telegraph office from the 11th of June 1890. This constitutes a most valuable improvement, and one serious cause of liability to failure in giving ample notice of the advance of storms to the north-west angle of the Bay has thus been removed.

57. The following extract from the report of the Meteorological Reporter to the Government of Bengal gives a brief statement of the cyclonic storms which affected the Bay during the year, and of the action taken to warn the ports concerned:—

“On the whole, the year 1890 was remarkably free from anything like very severe storms, but such storms as did occur were carefully watched, and their positions and their probable character and line of march were notified to the ports interested as far as could be done.”

“The dates of the principal storms occurring during the year are given in the first of the two tables below and the action taken by the Calcutta office in the matter of storm warnings and signals is indicated in the second of these tables” :—

Table giving a brief statement of the storms which affected the Bay of Bengal Coasts during the year 1890.

No. of storm.	Period of depression of storm.	Character of storm.	Coast affected.
1	June 17th to 19th .	Feeble depression, formed off the Orissa Coast.	Orissa Coast.
2	June 30th to July 2nd .	Small storm, formed in the north-west of the Bay.	Orissa Coast.
3	September 22nd to 23rd .	Feeble depression, formed in the Bay off Vizagapatam.	Circars and Orissa Coasts.
4	October 8th to 16th .	Small storm, formed in the south of the Bay.	Circars Coast.
5	October 20th to 22nd .	Feeble depression, formed in the east of the centre of the Bay.	Bengal Coast.
6	October 30th to November 1st.	Feeble depression, formed in the centre of the Bay.	Coromandel Coast.

Table showing the action taken by the Calcutta Meteorological Office in warning the coasts affected by the storms enumerated in the above table.

No. of storm.	HOISTING OF STORM SIGNALS.			WARNING OF PORTS BY CAUTIONARY TELEGRAMS.	
	Ports ordered to hoist signals.	When hoisted.	When lowered.	Ports warned by cautionary telegrams.	Time and date of despatch of cautionary telegrams.
1	Calcutta . . .	Ordered to hoist at 10-30 hours on 19th June.	Ordered to lower at 10 hours of 20th June.	Pooree . . .	10-36 hours of 19th June.
	Budge-Budge . .	12-37 hours of 19th June .	11-10 hours of 20th June .	False Point . .	10-40 " of 19th "
	Mud Point . . .	11-15 " of 19th " .	10-45 " of 20th " .	Balasore . . .	10-36 " of 19th "
	Diamond Harbour .	11-40 " of 19th " .	10-20 " of 20th " .	Chandbali . . .	10-40 " of 19th "
	Saugor Island . .	11-50 " of 19th " .	11-0 " of 20th " .	.....	.....
	Calcutta . . .	11-30 " of 30th " .	12-5 " of 1st July .	Chittagong . . .	10-6 hours of 30th June and 11-5 hours of 1st July.
2	Budge-Budge . .	11-40 " of 30th " .	11-20 " of 1st " .	Chandbali . . .	10-6 hours of 30th June.
	Mud Point . . .	11-20 " of 30th " .	11-30 " of 1st " .	False Point . .	Ditto ditto.
	Diamond Harbour .	11-15 " of 30th " .	11-15 " of 1st " .	Pooree . . .	Ditto ditto.
	Saugor Island . .	11-15 " of 30th " .	11-55 " of 1st " .	.....	.....
	Pooree . . .	3 P.M. of 1st July .	11-45 " of 2nd " .	Balasore . . .	10-6 hours of 30th June.
	False Point . . .	11-35 hours of 1st " .	11-40 " of 2nd " .	.....	.....
	Chandbali . . .	Noon of 1st " .	12-45 " of 2nd " .	.....	.....
	Balasore . . .	12-30 hours of 1st " .	12-45 " of 2nd " .	.....	.....
	.....	.....	.....	Pooree . . .	10-3 hours of 22nd September, 10-8 of 23rd, and 10-25 of 24th September.
	.....	.....	.....	False Point . .	Ditto ditto.
3	.....	.....	.....	Chandbali . . .	Ditto ditto.
	.....	.....	.....	Balasore . . .	Ditto ditto.
	Calcutta . . .	Noon of 11th October .	8 hours of 13th October	Gopalpore, Coconada, Vizagapatam, Masulipatam.	10-20 of 11th October, 10-15 of 12th, and 6 A.M. of 13th October.
	Budge-Budge . .	12-15 hours of 11th " .	6-55 " of 13th " .	.....	.....
4	Mud Point . . .	12-15 " of 11th " .	6-55 " of 13th " .	Madras . . .	10-3 A.M. of 11th October, 10-20 of 12th, and 6 A.M. of 13th October.
	Diamond Harbour .	12-5 " of 11th " .	7-10 " of 13th " .	Bimlipatam . .	10-20 of 11th October.
	Saugor Island . .	12-15 " of 11th " .	6-56 " of 13th " .	.....	.....
	Pooree . . .	2-10 P.M. of 11th " .	10-13 " of 13th " .	.....	.....
	False Point . . .	12-20 hours of 11th " .	7-35 " of 13th " .	.....	.....
	Chandbali . . .	12-40 " of 11th " .	11-20 " of 13th " .	.....	.....
	Balasore . . .	1-10 P.M. of 11th " .	Noon of 13th " .	.....	.....
	Calcutta . . .	1 A.M. of 21st " .	11-45 hours of 22nd October	Akyab . . .	11-3 P.M. of 20th October and 4-30 A.M. of 22nd October.
5	Budge-Budge . .	6 " of 21st " .	11-45 " of 22nd " .	Bassein . . .	Ditto ditto.
	Mud Point . . .	11-30 P.M. of 20th " .	11-0 " of 22nd " .	Rangoon . . .	Ditto ditto.
	Diamond Harbour .	11-55 " of 20th " .	11-25 " of 22nd " .	Moulmein . . .	Ditto ditto.
	Saugor Island . .	11-10 " of 20th " .	10-0 " of 22nd " .	Tavoy . . .	Ditto ditto.
	False Point . . .	7-15 A.M. of 21st " .	7-15 " of 22nd " .	Chittagong . .	11-28 P.M. of 20th, 4-30 A.M. and 10-37 A.M. of 22nd October.
	Chandbali . . .	7-15 " of 21st " .	7-22 " of 22nd " .	Pooree . . .	Ditto 4-50 A.M. of ditto.
	Balasore . . .	8-30 " of 21st " .	10-30 " of 22nd " .	False Point . .	Ditto ditto ditto.
	Pooree . . .	8-25 " of 21st " .	7-5 " of 22nd " .	Chandbali . . .	Ditto ditto ditto.
	Chittagong . . .	7-30 " of 21st " .	Noon of 22nd " .	Balasore . . .	Ditto ditto ditto.

Table showing the action taken by the Calcutta Meteorological Office in warning the coasts affected by the storms enumerated in the above table—continued.

No. of storm.	HOISTING OF STORM SIGNALS.			WARNING OF PORTS BY CAUTIONARY TELEGRAMS.	
	Ports ordered to hoist signals.	When hoisted.	When lowered.	Ports warned by cautionary telegrams.	Time and date of despatch of cautionary telegrams.
6	Coconada . . .	10-32 A.M. of 31st October and 10-15 A.M. of 1st November.
	Masulipatam . . .	Ditto ditto.
	Negapatam . . .	Ditto ditto.
	Madras . . .	10-35 A.M. of 31st October and 10-15 A.M. of 1st November.

58. *Bombay Storm Signal Service*.—This work was carried out during the past year by the Simla Meteorological Office under the system and arrangements introduced in September 1889, and fully stated in pages 17 and 18 of the Administration Report of 1889-90. No change was made, either in the methods or in the number of ports warned. The Simla office also warns the Madras ports on the Malabar Coast in the same manner as the Bengal Reporter warns the Madras ports on the coast of the Bay of Bengal.

59. The following is a complete list of the Bombay and Madras ports warned under this system by the Simla Meteorological Office :—

<i>Bombay Ports.</i>		
Kurrachee.	Porbandar.	Veraval.
Bhavnagar.	Damaun.	Bombay.
Alibag.	Ratnagiri.	Vengorla.
Goa.	Mormugao.	Karwar.
	Kumta.	

<i>Madras Ports.</i>		
Mangalore.	Calicut.	Cochin.

60. The following gives a list and brief description of the cyclonic storms or bad weather which affected the west coast of India during the year 1890-91 :—

No. of storm.	Period of depression or storm.	Character and track of storm.	Coast affected.
1	May 31st to June 5th . . .	On the 30th May wind shifted to south-east on the West Coast with rough sea; on the 31st barometer was falling briskly; winds strong from south-east; sea very rough. On June 1st similar conditions prevailed. Later reports showed that a cyclone formed off the coast, and moved north-westward to entrance to Persian Gulf, which it reached on June 5th.	Konkan, Kathiawar and Sind.
2	June 12th to 14th . . .	On the 10th the wind backed to south and south-east on Konkan Coast with a falling barometer. On the 11th barometer was still falling slowly. On the 12th the wind was easterly at Bombay and Veraval, and blew strongly, and the weather was very unsettled off the coast. This area of unsettled conditions also moved north-westward.	Konkan, Kathiawar and Sind.

No. of storm.	Period of depression or storm.	Character and track of storm.	Coast affected.
3	October 27th to November 3rd.	A shallow depression crossed the south of the Peninsula between the 27th and 29th, and passed out as a slight disturbance into the Arabian sea on the latter date. The disturbance apparently passed slowly up the West Coast, but the weather was at no time rough on the coast.	
4	November 4th to 6th . . .	On the 4th the wind at Veraval was easterly with a falling barometer, and on the 5th a well-marked low-pressure area was shown on the West Coast with its centre to the west of Karwar. On the 6th the low-pressure area was increasing, and the easterly wind at Veraval had increased to a gale. On the 7th conditions were very similar, but the barometer was rising, and the depression apparently filled up during the day.	

61. The following statement shows the action taken to warn the ports likely to be affected by each of the storms in the preceding list :—

No. of storm.	Date.	Hour of despatch of cautionary telegram or of telegram ordering signal to be hoisted.	PORTS WARNED BY	Number of signal hoisted.	Time of taking down signal.
			Cautionary telegram (c). " signal (s).		
1	31st May 1890 . 2nd June 1890 .	11.45 A.M. 4.35 P.M.	Bombay (c). Kurrachee, Bhavnagar, Daman, and Bombay (c).		
2	12th " "	4.26 P.M.	Kurrachee (c), Bombay (c and s) . . .	No. 1 . . .	Lowered on 13th.
3	30th Oct. " 2nd Nov. "	3.07 P.M. 6 P.M. .	Bombay (c). Bombay (c).		
	3rd " "	2.18 P.M.	Bombay, Veraval, Porbandar, Bhavnagar, and Daman (s).	No. 1 . . .	Lowered on 8th, except at Bombay, at which lowered on 6th.
4	6th " " 6th " "	2.58 P.M. ...	Bombay (s). Ratnagiri, Alibagh, Kurrachee, Vingorla, Goa, Mormugao and Karwar (s).	No. 2 . . . No. 1 . . .	Lowered on 8th. Lowered on 8th.

62. Ample warning was hence given of all the important storms which visited any part of the coasts of India and Burmah during the year, and this important section of the work of the Department appears to have been carried out effectively and satisfactorily, as no complaints or suggestions for improvements were received from any quarter.

FLOOD WARNINGS.

63. The methods by which this section of the work of the Department is at present carried on were stated in last year's Administration Report in paragraphs 70-74. No change was made during the past year in carrying out this work.

64. The following gives a list of the various Public Works and Irrigation officers who

are warned of the probable occurrence of heavy rain likely to give rise to floods, or of the actual occurrence of heavy rain in a district which is likely to be shortly followed by the occurrence of a flood which may cause damage to the public works, &c., under their control:—

- Pishin*.—Executive Engineer, Military Works, Irrigation Division.—Heavy rain at Quetta or Jacobabad (only during monsoon).
- Amritsar*.—Superintending Engineer, Bari Doab Canal (winter).—Heavy rainfall between Bias and Ravi rivers; also probability of heavy rain at the stations of Lahore, Amritsar and Gurdaspur.
- Saharanpur*.—Executive Engineer, North Western Railway.—Heavy rain exceeding 3 inches at Mussooree, Simla or Ranikhet.
- Saharanpur*.—Executive Engineer, Narora Division, Lower Ganges Canal.—Any unusual rainfall at Roorkee.
- Saharanpur, Jumna Canal*.—Executive Engineer, Eastern Jumna Canal Division.—Heavy rainfall between Hindun and Jumna, and also on the Siwalik range.
- Damoda*.—District Engineer, Bengal-Nagpur Railway.—Heavy rainfall at Hazaribagh or Ranchi.
- Dowlaishveram*.—Executive Engineer, Eastern Division, Godavery.—Warnings of high floods in the Godavery and of storms likely to cross the coast north of Masulipatam.
- Acquapada-Jajepur Division, Orissa Circle*.—Executive Engineer.—Warnings of any unusual rainfall over the area shaded in the sketch map furnished between the period June to October.
- Rupar*.—Sub-Divisional Officer, First Division, Rupar.—Any unusual rainfall in the valley of the Sutlej, north of the Siwaliks.
- North-Western Railway Station Jagadhari*.—Executive Engineer, Western Jumna Canal, Karnal Division.—Any unusual rainfall at Mussooree and Delhi (in the valley of the Jumna north of the Siwaliks).
- Ludhiana*.—Executive Engineer, Ludhiana Division, Sirhind Canal.—Any unusual rainfall over the tract bounded by the Siwaliks, the Sutlej and Ghaggar rivers, and the North-Western Railway.
- Patiala*.—Executive Engineer, Patiala Division, Sirhind Canal.—Any unusual rainfall over the tract bounded by the Siwaliks, the Sutlej and Ghaggar rivers, and the North-Western Railway.
- Vellore (North Arcot)*.—Executive Engineer, No. 7 District, South Indian Railway.—Heavy rainfall causing high floods likely to damage the bridgework on the River Palar.

65. On the 25th of September 1890 a letter was sent to all the Public Works officers to whom flood-warnings had been sent during the monsoon of 1890, asking for an expression of opinion regarding the success which had attended the flood-warnings, and for any suggestions as to changes and improvements in the methods of issuing these warnings. The following quotations from some of these letters show the general utility of the warnings. For instance, the Executive Engineer, Irrigation Division, Pishin, says "that he considers the telegraphic warnings of very great importance." The Executive Engineer, Narora Division, Lower Ganges Canal, says "that with the exception of one warning, namely, that on August 9th, the forecasts were followed by floods of more or less magnitude." The Executive Engineer, Upper Division, East Jumna Canal, says "two telegrams were of use—one on the 14th of August, pointing to the heavy Jumna flood of that date, and 2nd, on the 18th of September, showing the close of the long drought between the 18th of August and 16th of September, and pointing to the approaching rise in the Jumna river." The Executive Engineer, Sirhind Canal, Ludhiana, says "that the warnings were distinctly helpful;" and the Executive Engineer, Sirhind Canal, Patiala Division, says "I am of opinion that the telegrams you have sent me have been most valuable in giving me timely warning of rainfall, and on receipt of these I invariably sent warnings to all concerned."

66. The suggestions for improvements in the warning service are briefly—that all warning telegrams should be sent *Urgent*, and there is a general desire that, except in the case of very heavy falls, the forecast should be more general in character. Thus, one engi-

neer writes—"looking back on the rains just over, I would very much have liked to be warned that—

"(1) The continuous break in the rains from August 18th to September 16th was going to be such a prolonged break.

"(2) The rainfall of the 16th to 18th of September was approaching to put an end to the break."

And another engineer writes—"what affects the canal most is the occurrence of breaks and sudden heavy rain following breaks * * * * * It would of course do an appreciable saving had you been able to wire, say on the 15th or 16th, 'expect rain in the hills within three days.'"

67. There is a general desire that these warnings should be continued with the modifications suggested above.

68. Lieutenant-Colonel J. F. Miller, Superintendent of Public Works, Bari Doab, Amritsar, writes—"the remaining telegrams had reference to cold-weather storms; they were of deep interest, and during the current season, I shall value similar ones;" and the Executive Engineer, Quetta, writes—"I am much obliged to you for your warning. It reached Quetta at 6 P.M., and that same night heavy snow and rain fell, and have continued up to this date (22nd January 1891)."

69. The suggestions that have been received have been distinctly of a practical character, and the Simla office will endeavour to utilize them so far as it can in the issue of these telegrams during the monsoon rains of 1891 and the ensuing cold weather.

70. The following is the list of the Public Works and Canal officers to whom warnings of abnormal rainfall or forecasts of heavy rain were actually sent during the year, and the number of separate warnings (*i.e.*, warnings of different floods or storms):—

Names of officers to whom warnings were sent.	Number of warnings.
Superintending Engineer, Bari Doab Circle, Amritsar	13
Executive Engineer, Western Jumna Canal, Karnal Division, Dadupur, <i>via</i> Jagadhari	7
Ditto, North-Western Railway, Saharanpur	6
Ditto, Sirhind Canal, Ludhiana	3
Ditto, ditto, Patiala	1
District Engineer, Damuda	3
Superintending Engineer, 1st Circle, Dowlaishveram	1
Engineer-in-Chief, Chenab Bridge, Mooltan	1
Executive Engineer, Narora Division, Lower Ganges Canal, Saharanpur	4
Ditto, Eastern Jumna Canal Division, Saharanpur	3
Sub-Divisional Officer, 1st Division, Rupar	2
Executive Engineer, Patiala Division, Patiala	2
Ditto, Military Works, Irrigation Division, Pishin	1
Ditto, Eastern Division, Godavery, Dowlaishveram	1

WEATHER WARNINGS TO EXPEDITIONS IN THE FIELD.

71. The extremely inclement weather which was experienced by the Miranzai expedition immediately on its leaving Kohat suggested the question of the practicability of issuing warnings of approaching bad weather to troops in the field. The Secretary to the Government of India, in the Revenue and Agricultural Department, accordingly addressed the Military Department on the subject, pointing out that in many cases warnings could be given of approaching storms a day or two before their occurrence, and that on some occa-

sions the information might be useful. The Military Department accepted the suggestion, and requested that an experimental trial of the system might be made in the case of the Hazara Field Force, in order that the practical utility of the proposal might be tested. This acceptance was received in Simla in the beginning of April of this year (1891), hence the subject does not properly come into the present report; but it may perhaps be allowable to point out that by the time the acceptance of the proposal reached Simla, the period of the cold-weather storms was over and the period of spring thunder-storms had commenced, and that it will not be possible to test satisfactorily the value of such warnings until the next frontier expedition.

WEATHER REPORTS AND CHARTS.

72. *India Weather Reports*.—The following Weather Reports were published during the year by the India Meteorological Office, giving information of the current weather to the Government and the public :—

- (1) India Daily Weather Report and Chart.
- (2) Weekly Weather Report, published in the *Gazette of India* every Saturday, giving an account of the weather and of the rainfall of the week ending on the previous Tuesday.
- (3) Monthly Weather Report, giving a general summary of the more important features of the weather of the month and the variations from the normal meteorological conditions of the period. This Report has hitherto been published in the *Gazette of India*.

73. No change has been made in the form of the Daily Report during the past year. Weather telegrams from three additional stations have been included in the report during the year. The number of stations for which data were given daily in the report at the commencement of the year was 119, and at the end of the year was 122.

74. The following is a summary of the distribution list of the India Daily Weather Report as it stood on the 31st of March 1891 :—

	Number of recipients on the 31st March 1891.	Number of recipients on 31st March 1890.
Commissioners	21	21
Deputy Commissioners	46	45
Assistant Commissioners	3	5
Collectors	34	34
Editors	3	3
Miscellaneous	132	132
Foreign recipients	27	33
Additional copies for office record, &c.	15	16
TOTAL	281	287

75. The Weekly Weather Report was published in the same form last year as in 1889-90.

76. The Monthly Weather Reports were prepared in the same form as during the past two years and published in the *Gazette of India* until December 1890. Their publication was then stopped, as the Government of India sanctioned, with effect from January 1891, certain proposals I made for the discontinuance of the publication of the Annual Report in its present form and the preparation and issue of a Monthly Weather Review.

77. The first number of that Review for January 1891 was not ready for issue until the month of June 1891.

78. The Simla office prepared weekly charts (drawn by hand), showing the progress of the south-west monsoon rains of 1890 up to date during the period 15th May to 15th October for the use of His Excellency the Viceroy and the Secretary to the Government of India in the Revenue and Agricultural Department.

79. The Calcutta office prepared four series of average rainfall seasonal charts and annual rainfall charts of the whole of India, as in previous years, for the information of the Government of India and the Secretary of State.

80. *Bombay Daily Weather Report and Chart*.—The following extract from the Administration Report of the Meteorological Reporter for Western India describes its preparation during the past year :—

“The work of preparing and publishing the Bombay Daily Report and Chart has been continued in the same way as in the last year, and information of the approach of cyclonic storms, &c., regularly given to the mercantile community. The number of reporting stations remained the same as in 1888-89.

“The observations recorded daily at 8 A.M. at all these stations are received by telegram in the Bombay office. The telegrams begin to arrive at about 9-15 A.M., and as they come in they are translated into the corresponding instrumental readings. These are corrected, reduced, and entered on a chart, and also in the daily telegraphic observation report. Under the special arrangements sanctioned, the report embodying the observations and the summary is now despatched to the press at between 11 and 11-30 A.M., and the chart at about 11-45 A.M. The chart is always sent to the press about 10 to 15 minutes late, as some few telegrams (particularly that from Colombo) are always received late, and as their insertion in the chart often becomes necessary to correct the isobars on which the daily forecasts mainly depend. This delay, however, is insignificant, and does not affect the punctual issue of the report, which is always out of press and published by 2 o'clock. On Mondays and Thursdays, from the 1st of July to the 15th of February, additional information consisting of the weather and crop reports from the following stations has also been regularly prepared from the telegraphic reports and sent to the Central Press to be printed on the back of the daily report :—

Agra.
Delhi.
Cawnpore.
Bewar.
Nagpur.

Amraoti.
Khamgaon.
Barsi.
Sholapur.
Bellary.

Hubli.
Dhulia.
Jalgaum.
Broach.
Wadhwan.

Viramgaon.
Dholera.
Bhavnagar.

“The weekly rainfall statements from 48 stations on the Great Indian Peninsula, Rajputana-Malwa, and Bombay, Baroda and Central India Railways were also, on each Monday from the 1st July to the 17th of November, incorporated in the weather and crop reports. Short reports containing information of the weather experienced in the Arabian Sea by Peninsular and Oriental mail steamers were published weekly, as in the last year, and other reports from ships which appeared to be of sufficient importance were also often published in the daily reports, with two objects : firstly, to give the general public an opportunity to compare with these reports the forecasts framed in the daily weather reports from the coast and the inland station observatories ; secondly, to give an idea to the captains of vessels just leaving the port as to the general character of weather prevailing in the Arabian Sea.

“It is now two years since the publication of the Bombay Daily Weather Report and Chart was inaugurated, and it is satisfactory to be able to report that the system continues to work smoothly and well, and is, it is believed, thoroughly appreciated by the mercantile and marine community. The report continues to be published in the daily papers.

"Owing to the inconvenience of printing the chart, report, and summary on Sundays and four other holidays, they are sent to the press on the following day, and two reports are then published and distributed together. On every Sunday and four other holidays a special report containing all the observations made at Kurrachee, Rajkot, Raipur, Surat, Bombay, Poona, Sholapur, Ratnagiri, Belgaum, Goa, Karwar, Mangalore, Calicut, Cochin, Bangalore, Secunderabad, Masulipatam, Bellary, Cuddapah, Madras, Coimbatore, Trichinopoly, Negapatam and Colombo is forwarded to the Port Officer, Bombay, and, whenever necessary, short remarks on the weather are added at the foot of the report, and a rough chart showing the distribution of pressure at the time of unsettled weather is also supplied to that officer when necessary."

81. The chart and observations are very neatly and expeditiously printed at the Bombay Government Press. Mr. Hutchinson and the Bombay Meteorological Office deserve much credit for the very satisfactory manner in which the report was issued during the past year.

82. *Bengal Weather Reports and Charts*.—The Calcutta Meteorological Office published the following reports during the year:—

(1st) *Daily Weather Report and Chart of the Bay of Bengal*.—This is prepared in connection with the Bay of Bengal Storm Signal Service, and includes the 8 A.M. observations taken at 28 stations on and near the coast of the Bay of Bengal from Tavoy to Negapatam and Galle. It was published daily throughout the year, Sundays and holidays included, at about 10-45 A.M. No change was made in its form during the year. It was supplied to 24 paying subscribers (subscription Rs 2 per mensem) and to 48 non-paying recipients, chiefly Government officers. The receipts from subscribers during the year covered the cost of printing and distributing the reports.

(2nd) *The Bengal Daily Weather Report*.—This is prepared and issued chiefly for the information of the Government of Bengal and its District Officers to show the progress of the south-west monsoon rains and to give current meteorological information to the Government during the period of the year when it is of the greatest value. It was published in 1890 during the period April 26th to October 31st, and gave information based on telegrams received from 45 observatories in Bengal and Assam. It is distributed to 103 Government officials and to 16 subscribers (chiefly mercantile firms in Calcutta interested in accurate rainfall data). Five series of Charts (drawn by hand) are prepared daily throughout the year, but not published.

(3rd) *The Bengal Weekly Meteorological Report*, published in the *Calcutta Gazette*, giving the weekly means of observations at 52 meteorological observatories in Bengal and Assam, and complete rainfall data of 255 rainfall-registering stations in Bengal for the previous week, and a summary of the chief features of the weather during the week.

(4th) *The Bengal Monthly Meteorological Report*, also published in the *Calcutta Gazette*, gives the monthly means of the meteorological data furnished by 47 observatories in Bengal and Assam, and complete rainfall data of the province (including the returns of 251 rain-gauge stations), and a full discussion of the weather and meteorology of the month. In connection with this, three sets of rainfall charts showing the actual rainfall of the month; the variation from the normal rainfall of the month, and the variation expressed as a percentage, were prepared monthly from these data for the information of the Bengal Government and its Sanitary Commissioner.

(5th) A summary of the more important features of the south-west monsoon of 1890, and a statement of the distribution of the rainfall in the province during the monsoon period, for the information of the Government of Bengal. A series of hand-drawn charts embodying the chief features was prepared for the information of the Bengal Government. The summary was published in the *Calcutta Gazette* of December 31st, 1890.

(6th) A general report of the meteorology of Bengal for 1889, giving a meteorological summary for the whole year, was also prepared and submitted to Government in July for incorporation in the Bengal Administration Report. It was illustrated by maps showing the actual rainfall of the year and its percentage variation from the normal.

83. In the North-Western Provinces, monthly abstracts of the observations of the several observatories and weekly rainfall reports were published in the Local Government Gazette during the year, and in the Punjab a descriptive summary of the weather of the province was prepared monthly in the Simla office for the information of the Punjab Government and published in like manner. The Reporter for Western India published in the *Bombay Government Gazette* monthly abstracts of the observations of the several observatories. The Madras Reporter published a monthly statement of rainfall in the *Fort St. George Government Gazette*.

84. The Simla office drew up a preliminary report giving a summary of the weather in 1889, which was published in the *Gazette of India*. The Reporters for Western India and the North-Western Provinces drew up brief sketches of the meteorology of their respective provinces in 1889-90 for the information of their respective Governments.

ANNUAL REPORTS AND OCCASIONAL PUBLICATIONS.

85. The Administration Reports of the various Provincial Reporters for the year 1890-91 (utilized in the preparation of the present report) were received on the following dates:—

Bombay	.	.	.	.	.	.	.	.	.	1st June 1891.
Bengal	.	.	.	.	.	.	.	.	.	17th " "
North-Western Provinces and Oudh	.	.	.	.	.	.	.	.	.	22nd " "
Madras	.	.	.	.	.	.	.	.	.	Not received.

86. The Administration Report for the year 1889-90 was prepared shortly after the receipt of the Provincial Administration Reports, printed in Calcutta, and submitted to Government on the 16th October 1890.

87. The annual report on the meteorology of the previous year 1889 was finished and placed in the printer's hands in September 1890, and was submitted to Government on the 31st March 1891. It gives tables of temperature for 90 stations, and rainfall returns for 506 stations, being a decrease of fifty in the case of the former and of two in that of the latter, on the numbers respectively given in the report for 1888. The descriptive letter-press discusses the chief characteristics of the meteorology of the year, and includes tables of the average values of all the more important meteorological elements for all stations that have furnished returns for four years and upwards. The report is illustrated with ten plates, *viz.*, a chart showing the position of all observ-

atories and rain-gauge stations, three in coloured lithography, representing the mean distribution of temperature, pressure, and winds in each month of the year, and one showing the tracks of the storms which originated in the Bay of Bengal during the year, and five plates illustrating the pressure and temperature features and conditions accompanying two of the cold-weather storms of 1888-89, *viz.*, the storm of 27th January to 3rd February and the storm of 16th to 21st February.

88. The original observations of seven observatories, *viz.*, Calcutta, Lucknow, Allahabad, Lahore, Nagpur, Bombay and Madras, for 1889 were included in the Annual Report and published as Appendix B.

89. The following publication was issued during the year:—

Part III of the Cyclone Memoirs, giving an account of the cyclonic storm of 13th to 20th September 1888, and of the cyclone in the Bay of Bengal in the last week of October 1888, and the *Vaitarna* storm of 6th to 9th November 1888 in the Arabian Sea.

90. The following were completed during the year, and were almost ready for issue at the end of the year:—

(1) Part VII of Volume IV of the Indian Meteorological Memoirs containing two papers, *viz.*—

(1st) Account of the storm of the first week of June 1887 in the Arabian Sea, by Mr. F. Chambers, late Meteorological Reporter for Western India.

(2nd) The Meteorology and Climatology of Afghanistan, based on meteorological observations taken by officers of the Afghan Delimitation Commission, by Mr. W. L. Dallas.

(2) Part IV of the Cyclone Memoirs, containing an enquiry into the nature and course of storms in the Arabian Sea and a catalogue and brief history of all recorded cyclones in that Sea from 1648 to 1889, by Mr. W. L. Dallas.

91. Mr. Blanford, as was stated in last year's Report, agreed to take up the discussion of the complete series of hourly observations recorded during the past 14 years in India. It was decided that he should give a statement of the results for each station in separate memoirs, and a summary of conclusions and results deduced from the complete series in a final memoir. The results for two stations, Sibsagar and Dhubri, were recently received and sent to press. The results for Simla and Patna are also practically ready for publication, and will be shortly sent to press. The whole of these memoirs will form Volume V of the Indian Meteorological Memoirs.

92. The two following papers for the seventh and final part of Volume IV of the Indian Meteorological Memoirs are practically ready for press, and will be sent as soon as the annual report for 1890 has been printed off. The papers are—

(1st) The relation between sunspots and weather as shown by meteorological observations taken on board ships in the Bay of Bengal during the years 1855 to 1878, by Mr. Dallas, First Assistant Meteorological Reporter to the Government of India.

(2nd) An account of the cold-weather storms of the years 1876 to 1889, in Northern India, with an analysis and explanation of the chief phenomena of these storms.

PART II.—DETAILS OF ADMINISTRATION.

METEOROLOGICAL OFFICERS.

93. The general administration of the meteorological observatories and offices in the different provinces has been in the hands of the following officers during the year:—

Names.	Office.	Provinces.
John Eliot, Esq., M.A., F.R. MET. SOC.	Meteorological Reporter to the Government of India.	Central Office.
W. L. Dallas, Esq.	First Assistant Meteorological Reporter to the Government of India.	
C. Little, Esq., M.A.	Second Assistant Meteorological Reporter to the Government of India.	
J. H. Gilliland, Esq., M.A., (Offg.) Lala Hem Raj	Personal Assistant to the Meteorological Reporter to the Government of India.	
A. Pedler, Esq., F.C.S.	Meteorological Reporter to the Government of Bengal.	Bengal and Assam.
C. Little, Esq., M.A. (Offg.) S. A. Hill, Esq., B.Sc., F.R. MET. SOC.	Meteorological Reporter to the Government of North-Western Provinces and Oudh.	North-Western Provinces, Oudh, Rajputana and Central India (part).
J. Eliot, Esq., M.A., F.R. MET. SOC. W. L. Dallas, Esq.	Meteorological Reporter to the Government of Punjab.	Punjab.
S. A. Hutchinson, Esq. G. M. Robinson, Esq. (Offg.) Miss Isis Pogson, F.R. MET. SOC.	Meteorological Reporter for Western India. Meteorological Reporter to the Government of Madras.	Bombay, Berar, Rajputana and Central India (part). Madras, Mysore, Coorg and Hyderabad.
Dr. J. G. Pilcher	Sanitary Commissioner, Central Provinces.	Central Provinces.
Dr. C. Little	Sanitary Commissioner, Berar.	Berar.
Dr. D. Sinclair	Sanitary Commissioner, Burma.	Burma.

94. Mr. Pedler went on furlough for seven and a half months from the 9th April to 26th November 1890. Mr. Little acted as Meteorological Reporter to the Government of Bengal during his absence, and Mr. Gilliland, Professor of Mathematics in the Presidency College, acted for Mr. Little.

95. Mr. Hill died on the 23rd September 1890, and no successor was appointed during the year. The Head Clerk was placed in charge of the office, but the more important work of the Allahabad office, such as the preparation of the monthly meteorological returns for the *Gazette*, the Administration Report, and the correspondence has been carried on in the Simla office either by Mr. Dallas or by myself.

96. Mr. Hutchinson, Meteorological Reporter for Western India, was temporarily transferred to Madras for three months from 3rd May to 6th August 1890. During his absence Mr. G. M. Robinson, Superintendent, Bombay Telegraph Office, acted as Reporter for Western India.

OBSERVATORIES.

97. At the commencement of the year there were 178 observatories contributing registers of meteorological data.

98. The observations of twenty-two of the stations in Bengal were, from the beginning of the year until the end of December 1890, utilized only in the preparation of the daily, weekly and monthly reports of the Bengal Meteorological Department, but from January 1891 the observations of these stations were included in the India Monthly Weather Review.

99. Observatories were opened at the following stations during the year :—

Paumben	on the 2nd January 1891.
Minicoy	on the 21st January 1891.

The observatory shed at Perim for the observatory sanctioned some time ago was erected during the year, but the work of observation was not commenced until June 1891.

100. Voluntary observatories (to which the Meteorological Department supplied the necessary instruments) were established at the Shebo Forest Plantation in Beluchistan (under the control of the Beluchistan Forest Department), Sehore in Bhopal (under the control of the Agency Surgeon), Mormagoa (under the control of the Resident Engineer, Portuguese West Coast Railway), Fort Tregear in the Chittagong Hill Tracts (under the control of the Medical Officer in charge of that Military Station) and Kalimpong in Darjeeling (under the supervision of the Revd. Mr. Sutherland).

101. The observatories maintained by the Government of India are classified as follows :—

First class.—Observatories which are furnished with autographic instruments for recording pressure, temperature, humidity, rainfall and wind direction and velocity, either continuously or at intervals of 10 minutes, or which take special solar actinometric observations.

Second class.—Observatories at which observations are taken daily at 8 hours which (with one or two exceptions) are transmitted to Simla by weather telegrams, and are included in the India Daily Weather Report, and also at 10 and 16 hours.

Third class.—Observatories which are of two kinds :—

- (a) those at stations where there are telegraph offices, and which record 8 hours' observations only for transmission daily to Simla, Bombay, or Calcutta by weather telegrams ;
- (b) those at which there are no telegraph offices and which record 10 and 16 hours' observations, in some cases for inclusion in the annual report and in others to furnish a series of 11 years' observations, and thus enable monthly and daily means to be obtained for these stations which shall be comparable with those already obtained for the second-class observatories.

Fourth class.—Observatories at which observations of temperature and rainfall only are recorded.

102. The following gives the arrangement of the observatories maintained by the Government of India, or supplied with instruments by the Meteorological Department and working in connection with it, according to this classification, on the 31st of March 1891 :—

BENGAL AND ASSAM.

	Class.		Class.		Class.
Calcutta (Alipore)	1st.	Durbhunga	2nd.	Balasore	3rd.
Berhampore	2nd.	False Point	"	Bankoora	"
Burdwan	"	Hazaribagh	"	Bhagulpur	"
Chittagong	"	Patna	"	Bogra	"
Cuttack	"	Saugor Island	"	Burrisal	"
Dacca	"	Sibsagar	"	Buxar	"
Darjeeling	"	Silchar	"	Chupra	"
Dhubri	"	Arrah	3rd.	Chyebassa	"

BENGAL AND ASSAM—continued.

	Class.		Class.		Class.
<i>Comilla</i>	. 3rd.	<i>Maldah</i>	. 3rd.	<i>Rampur-Bauleah</i>	. 3rd.
<i>Dehree</i>	. "	<i>Midnapore</i>	. "	<i>Ranchee</i>	. "
<i>Dinagepur</i>	. "	<i>Motihari</i>	. "	<i>Ranigunj</i>	. "
<i>Fort Tregear</i>	. "	<i>Mozufferpore</i>	. "	<i>Rungpur</i>	. "
<i>Furreedpore</i>	. "	<i>Mymensingh</i>	. "	<i>Serajgunj</i>	. "
<i>Gya</i>	. "	<i>Noakholly</i>	. "	<i>Shortt's Island</i>	. "
<i>Jessore</i>	. "	<i>Nya-Doomka</i>	. "	<i>Calcutta (Chowringhee)</i>	. "
<i>Julpigoree</i>	. "	<i>Pedong</i>	. "	<i>Demagiri</i>	. 4th.
<i>Krishnaghur</i>	. "	<i>Pooree</i>	. "	<i>Tura</i>	. "
<i>Lungleh</i>	. "	<i>Purneah</i>	. "		

NORTH-WESTERN PROVINCES.

	Class.		Class.		Class.
<i>Allahabad</i>	. 1st.	<i>Roorkee</i>	. 2nd.	<i>Gorakhpur</i>	. 3rd.
<i>Agra</i>	. 2nd.	<i>Bareilly</i>	. 3rd.	<i>Jhansi</i>	. "
<i>Dehra</i>	. "	<i>Benares</i>	. "	<i>Mussooree</i>	. "
<i>Lucknow</i>	. "	<i>Cawnpore</i>	. "	<i>Pithoragarh</i>	. "
<i>Meerut</i>	. "	<i>Chakrata</i>	. "		
<i>Ranikhet</i>	. "	<i>Ghazipur</i>	. "		

PUNJAB AND KASHMIR.

	Class.		Class.		Class.
<i>Lahore</i>	. 1st.	<i>Peshawar</i>	. 2nd.	<i>Khushab (Shahpur)</i>	. 3rd.
<i>Simla</i>	. "	<i>Chamba</i>	. 3rd.	<i>Montgomery</i>	. "
<i>Ludhiana</i>	. 2nd.	<i>Delhi</i>	. "	<i>Rawalpindi</i>	. "
<i>Mooltan</i>	. "	<i>Dera Ismail Khan</i>	. "	<i>Sialkot</i>	. "
<i>Murree</i>	. "	<i>Kailang</i>	. "	<i>Sirsa</i>	. "

CENTRAL PROVINCES.

	Class.		Class.		Class.
<i>Hoshangabad</i>	. 2nd.	<i>Pachmarhi</i>	. 2nd.	<i>Chanda</i>	. 3rd.
<i>Jubbulpore</i>	. "	<i>Raipur</i>	. "	<i>Sambalpur</i>	. "
<i>Khandwa</i>	. "	<i>Saugor</i>	. "	<i>Sironcha</i>	. "
<i>Nagpur</i>	. "	<i>Seoni</i>	. "		

BERAR.

	Class.		Class.		Class.
<i>Akola</i>	. 2nd.	<i>Buldana</i>	. 3rd.	<i>Makhla</i>	. 3rd.
<i>Amraoti</i>	. 3rd.	<i>Chikalda</i>	. "		

CENTRAL INDIA AND RAJPUTANA.

	Class.		Class.		Class.
<i>Ajmere</i>	. 2nd.	<i>Bickaneer</i>	. 3rd.	<i>Sambhar</i>	. 3rd.
<i>Mount Abu</i>	. "	<i>Indore</i>	. "	<i>Sehore</i>	. "
<i>Nowgong</i>	. "	<i>Neemuch</i>	. "		
<i>Sutna</i>	. "	<i>Pachpadra</i>	. "		

BOMBAY.

	Class.		Class.		Class.
<i>Belgaum</i>	. 2nd.	<i>Poona</i>	. 2nd.	<i>Mormugao</i>	. 3rd.
<i>Deesa</i>	. "	<i>Ratnagiri</i>	. "	<i>Rajkot</i>	. "
<i>Hyderabad</i>	. "	<i>Sholapur</i>	. "	<i>Surat</i>	. "
<i>Jacobabad</i>	. "	<i>Ahmednagar</i>	. 3rd.	<i>Veraval</i>	. "
<i>Karwar</i>	. "	<i>Bhuj</i>	. "		
<i>Karachi</i>	. "	<i>Malegaon</i>	. "		

MADRAS.					
	Class.		Class.		Class.
Bellary	2nd.	Calicut	3rd.	Madras (Port Office)	3rd.
Cochin	"	Coconada	"	Mangalore	"
Mercara	"	Coimbatore	"	Masulipatam	"
Salem	"	Cuddalore	"	Negapatam	"
Secunderabad	"	Cuddapah	"	Nellore	"
Tichinopoly	"	Gopalpore	"	Paumben	"
Wellington	"	Kurnool	"	Rajahmundry	"
Bangalore	3rd.	Madura	"		
BURMA.					
	Class.		Class.		Class.
Akyab	2nd.	Bassein	3rd.	Moulmein	3rd.
Diamond Island	"	Bhamo	"	Tavoy	"
Mergui	"	Kindat	"	Thyetmio	"
Rangoon	"	Mandalay	"	Toungthoo	"
BAY ISLANDS.					
	Class.		Class.		Class.
Port Blair	2nd.	Cocos Island	3rd.		
EXTRA INDIA.					
	Class.		Class.		Class.
Aden	2nd.	Amini Divi	3rd.	Meshed	3rd.
Leh	"	Baghdad	"	Seychelles	"
Minicoy	"	Bushire	"	Zanzibar	"
Quetta	"	Katmandu	"		

103. The stations given in italics in the previous list are those which contributed registers up to the month of December 1890 to the Bengal Reporter only.

104. The important Government observatories of Bombay and Madras are independent of the Department, and publish separate annual reports for the information of Government.

105. Cocos Island, Demagiri, Fort Tregear, Ghazipur, Lungleh, Meerut, Meshed, Nowgong, Pedong, Sehore, Shortt's Island, and Tura, are voluntary observatories to which the instruments are supplied by the Meteorological Department, but the observations are taken by some local arrangement (and generally by volunteer agency).

106. The observatory at Makhla is maintained by the Forest Department for the purpose of recording special observations bearing on the influence of forests on rainfall.

107. Observations are also furnished regularly to the Department by the six independent observatories of Jeypore, Vizagapatam, Trivandrum, Bhavnagar, Goa and Mormugoa. The second is maintained by a private gentleman, A. V. Nursing Row, Esq., F. R. A. S., F. R. G. S.; the first, third and fourth by the native states in which they are situated; the fifth by the Portuguese Government, and the sixth by the West of India Portuguese Guaranteed Railway Company.

108. Regular observations are also taken on board the Light Vessels at the entrance to the River Hooghly in accordance with arrangements made by the Port Commissioners, and are furnished to the Department. They are chiefly utilised in the discussion of the cyclonic storms of the Bay of Bengal. Registers of observations were received from the following light vessels during the year :—

F. L. V. Star, stationed at the *Lower Gasper Station*, from 1st May to 30th June, and 1st to 31st August 1890, and 1st to 28th February 1891.

F. L. V. Comet, stationed at the *Lower Gasper Station*, from 1st September 1890 to 31st January 1891.

F. L. V. Canopus, stationed at the *Mutlah Station*, from 4th April to 30th October 1890, and 2nd January to 28th February 1891.

109. *First Class Observatories.—The Alipore Observatory.*—This observatory is under the charge of the 2nd Assistant Meteorological Reporter to the Government of India. It is furnished with a complete set of autographic instruments, including a sunshine-recorder, a Kew barograph and thermograph, a Beckley's anemograph, an Osler's anemometer and a Beckley's rain-gauge. All instruments that are issued by the Meteorological Department are carefully tested at the observatory, and their corrections ascertained before they are sent out for use. Another important part of its work is the dropping daily of two time-balls at 1 P.M., local mean time for the port of Calcutta.

110. The self-registering instruments have worked very satisfactorily during the past year. The measurements from the traces of the barograph and thermograph have been compared with the eye-readings of the standard barometer and the wet and dry bulbs in the same manner as in the previous five years. The following gives the mean differences for each year of the past six years :—

	1885.	1886.	1887.	1888.	1889.	1890.
Mean difference between the standard barometer and barograph during the year (<i>i.e.</i> , standard barometer <i>minus</i> barograph)	+ '025"	+ '026"	+ '027"	+ '026"	+ '024"	+ '020"
Mean difference between the dry bulb in the thermometer shed and the dry-bulb trace of the thermograph (<i>i.e.</i> , thermograph <i>minus</i> shed dry-bulb thermometer)	+ '4°	+ '5°	+ '6°	+ '7°	+ '7°	+ '8°
Mean difference between the wet-bulb in the thermometer shed and the wet bulb trace of the thermograph (<i>i.e.</i> , thermograph <i>minus</i> wet-bulb thermometer)	+ '6°	+ '5°	+ '7°	+ '8°	+ '7°	+ '9°

111. The number of instruments verified during the year (1890-91) and the previous four years (given for comparison) is shown by the following table :—

INSTRUMENTS.	1886-87.	1887-88.	1888-89.	1889-90.	1890-91.
Barometers	52	52	74	46	99
Aneroids	10	15	16	20	15
Dry and wet-bulb thermometers	62	31	41	36	85
Standard thermometers	1	8	...	...	40

INSTRUMENTS.	1886-87.	1887-88.	1888-89.	1889-90.	1890-91.
Maximum thermometers for air temperature . . .	46	6	50	28	56
Minimum „ „ „ „ . . .	55	21	45	46	98
„ „ „ „ nocturnal radiation . . .	18	10	9	14	17
Solar radiation thermometers	20	20	5	19	14
Dial anemometers . . . . .	...	...	...	12	46
Sand-glasses . . . . .	...	...	16	17	28
Sling thermometers	2	3	...	...	11
Traveller's maximum and minimum thermometers, in pairs	...	1	1	...	4
Six's thermometers . . . . .	...	...	...	...	2
Common thermometers . . . . .	...	1	2	1	...
Boiling point thermometers	6	2	...	...	...
Sunshine-recorder . . . . .	...	...	...	1	...
Pressure gauge . . . . .	...	...	...	1	...
Salinometer . . . . .	...	...	1	...	...
Hydrometer . . . . .	...	...	1	...	...
Rain-gauges	4	2	...	...	...
Measure glasses for rain-gauges	4	2	...	...	...
TOTAL .	280	174	261	241	515

112. The preceding statement shows that an unusually large amount of work was done during the past year in verifying instruments. The work had been allowed to fall to some extent into arrears during the past two years, and as this was causing some inconvenience, instructions were given to examine carefully all instruments in store, reject all that were unserviceable, and bring up the work of verification to date. This was thoroughly done during the months of January, February and March, and this portion of the work of the Alipore observatory is on a more satisfactory footing than it has been for some years. This important portion of the work of the Alipore observatory will continue to increase largely during the next two years, as the work of testing all rain-gauges before issue to rain-fall stations in India has been handed over to it. Satisfactory arrangements have been made with the Mathematical Instrument Department, who supply the rain-gauges to enable an officer of the Alipore Observatory to perform this work before the issue of the instruments.

113. The following table gives a statement of the instruments received from England or returned from observatories or after repair from the Mathematical Instrument Department and issued (properly verified) during the past year (1890-91) to the Central Office for distribution to observatories when required, and of those that awaited or were actually under verification at the beginning and at the end of the year. It also shows the instruments

that were examined or verified but condemned, and those that were kept in reserve for further examination at the Alipore Observatory :—

INSTRUMENTS.	Awaiting verification at the beginning of the year.	Under verification at the beginning of the year.	Received.	Issued after verification.	Under verification at the end of the year.	Awaiting verification at the end of the year.	Condemned.	Kept in reserve at the Alipore Observatory.
Barometers . . .	43	6	77	107	0	8	11	0
Aneroids . . .	6	0	10	16	0	0	0	0
Dry and wet-bulb thermometers.	32	16	51	89	3	2	5	0
Maximum thermometers for air temperature.	73	9	22	58	7	1	37	1
Minimum thermometers for air temperature.	34	10	72	105	0	9	0	2
Minimum thermometers for nocturnal radiation.	13	4	6	19	3	0	0	1
Solar radiation thermometers.	17	10	1	24	0	0	4	0
Standard thermometers .	41	0	2	40	0	1	2	0
Dial anemometers . .	7	4	42	42	0	5	6	0
Sand-glasses . . .	16	0	15	28	0	0	3	0
Six's thermometers . .	4	0	2	2	4	0	0	0
Sling " . . .	12	0	0	12	0	0	0	0
Traveller's maximum and minimum thermometers, in pairs.	5	0	0	1	0	0	0	4
TOTAL .	303	59	300	543	17	26	68	8

114. The time-ball on the Semaphore Tower, Fort William, and that on the roof of the Port Commissioners' office were accurately dropped on all days, Sundays and holidays inclusive, except on the undermentioned days, when it failed to drop properly for the reasons given in the table :—

Date of failure.	Nature of failure.	Cause of failure.
17th May 1890 . . .	Time-ball at the Port Commissioners' office failed altogether.	Either telegraphic defect or failure of the time-ball workmen to set the time-ball trigger properly.
24th " " . . .	Time-ball on the Semaphore Tower, Fort William, dropped about 3 seconds after mean 1 P.M.	Telegraphic defect.
28th " " . . .	Time-ball at the Port Commissioners' office failed altogether.	Defect in the telegraphic line or time-ball trigger.
29th " " . . .	Ditto ditto ditto	Ditto ditto ditto.
28th June 1890 . . .	Ditto ditto ditto	Telegraphic defect.
26th July 1890 . . .	Time-ball at the Port Commissioners' office was hoisted, but it failed to drop at the usual signal.	Ditto ditto.
31st July 1890 . . .	Time-ball on the Semaphore Tower, Fort William, dropped about 35 seconds after mean 1 P.M.	Ditto ditto.
2nd August 1890 . . .	Time-ball at the Port Commissioners' office was hoisted, but it failed to drop at the usual signal.	Ditto ditto.

Date of failure.	Nature of failure.			Cause of failure.		
10th November 1890	Time-ball at the Port Commissioners' office failed altogether.			Either telegraphic defect or failure of the time-ball workmen to set the time-ball trigger properly.		
1st December 1890	Ditto	ditto	ditto	Ditto	ditto	ditto.
24th „ „	Ditto	ditto	ditto	Ditto	ditto	ditto.
28th „ „	Ditto	ditto	ditto	Telegraphic defect.		
5th January 1891	Ditto	ditto	ditto	Ditto	ditto.	
7th „ „	Ditto	ditto	ditto	Ditto	ditto.	
3rd February 1891	Time-ball on the Semaphore Tower, Fort William, failed altogether.			Ditto	ditto.	
30th March 1891	Ditto	ditto	ditto	Ditto	ditto.	

115. *The Allahabad Observatory.*—The use of the meteorograph was, for reasons fully explained in last year's report, discontinued from the 1st of April 1890. In order to take the frequent observations necessary at a first-class observatory, a temporary establishment was engaged from that date. The present staff of observers record hourly observations during fine weather and observations at intervals of ten minutes or oftener during disturbed or stormy weather. This arrangement will be continued until it has been finally decided whether it will be more satisfactory to record the observations continuously and automatically by a complete set of self-registering instruments, or to employ clerical labour, which is comparatively cheap in India, and adapt the system and methods of observation to the weather at the time.

116. During the year under review two automatic instruments, *viz.*, a Draper's thermograph and a Beckley's anemograph, were brought into use. The first of the two, *viz.*, the thermograph, worked fairly satisfactorily, although the tabulated traces show that the temperatures, as registered by it, vary considerably from those recorded by the ordinary thermometers placed under practically the same conditions. Corrections are, however, being determined from the past year's observations, and if the observations of the present year show that the differences between the thermograph and the ordinary thermometers do not change from year to year, the instrument, which is very simple in construction and easy to manage, will be a valuable adjunct to the eye-observations of temperature. The anemograph was brought into use on the 1st September, and worked satisfactorily until the 20th of February, when it suddenly went wrong. The defect was shortly afterwards remedied. The sunshine-recorder did well without a break.

117. The observers have all worked satisfactorily. At the end of the year, the work of the office, with the exception of the tabulation of a portion of the thermograph traces, was up to date. The chief observer, Babu Kedar Nath Chatterjee, who is also head clerk, deserves much credit for the manner in which he has carried on the current duties of the office since Mr. Hill's death.

118. *The Lahore Observatory.*—At this observatory continuous observations with self-recording instruments were taken throughout the year, and with the exception of a few brief stoppages mainly caused by the necessity of cleaning the instruments there has been no break in the continuity of the observations. The Draper barograph has worked

exceedingly well, but the hygrometer has not been quite satisfactory, and it is doubtful if the instrument is one perfectly adapted to the Punjab climate. In September last the two parts of the metallic bar of the wet thermometer suddenly separated, but on being repaired, the readings given were as correct as before the reparation. A long series of comparative observations, *i.e.*, observations of the self-recording and of the ordinary instruments, will shortly be available, and when this is the case, an exhaustive comparison will be instituted and corrections, if necessary, determined for the instruments. Cloud and storm observations now form part of the work of the observers, and during the cold-weather tour of the Meteorological Reporter to the Government of the Punjab, the attention not only of the observers at Lahore, but also of the observers at the out-stations, was called particularly to the necessity of obtaining careful and detailed observations of the weather before and during the progress of the winter storms, in order to increase our knowledge of these phenomena.

119. The work of the observers at Lahore has been carefully and satisfactorily performed during the year.

SPECIAL OBSERVATIONS.

120. The following were the classes of special observations taken during the past year at certain stations:—

1st.—Wind observations recorded by self-registering instruments (Beckley's anemograph) at 15 stations.

2nd.—Solar and terrestrial observations at 31 stations from the beginning of the year to the 31st December.

3rd.—Seismic observations at Sibsagar and Silchar in Assam.

4th.—Special storm observations.

121. The following statement gives a summary of the work done at the 15 stations furnished with Beckley's anemograph:—

Station.	Anemograms supplied.	Amount of data reduced and tabulated at the Calcutta Meteorological Office up to the end of official year.	Character of anemograms.
Allahabad . . .	2nd to 23rd September, 25th September 1890 to 20th February, 24th February to 26th February to 31st March 1891 .	2nd September 1890 to 31st March 1891.	Distinct.
Belgaum . . .	7th April 1890 to 19th May, and 5th June to 31st March 1891.	None.	
Calcutta (Alipore) . . .	1st April 1890 to 31st March 1891 . . .	1st April 1890 to 31st March 1891.	Distinct.
Chittagong . . .	1st April 1890 to 15th October, and 17th October to 31st March 1891.	None.	
Darjeeling . . .	1st April 1890 to 5th April, 12th to 16th April, 21st to 29th April, 13th May to 9th February 1891, and 14th February to 31st March 1891.	None.	
Deesa . . .	1st April 1890 to 31st March 1891.	None.	
Dehra . . .	Ditto ditto	1st April to 30th September 1890.	Faint, but measurable.

Station.	Anemograms supplied.	Amount of data reduced and tabulated at the Calcutta Meteorological Office up to the end of official year.	Character of anemograms.
Dhubri . . .	1st April 1890 to 31st March 1891 . .	None.	
Jubbulpore . . .	1st April 1890 to 3rd September. 5th September to 31st December 1890, and 7th January 1891 to 31st March 1891.	None.	
Lahore . . .	1st April 1890 to 31st March 1891 . .	None.	
Lucknow . . .	Ditto ditto	1st April to 31st July 1890, and 1st January to 31st March 1891.	Distinct.
Nagpur . . .	Ditto ditto	1st January to 31st March 1891.	Ditto.
Rangoon . . .	1st April 1890 to 17th May, and 21st May to 31st March 1891.	None.	
Roorkee . . .	1st April 1890 to 23rd May, 25th May 1890 to 22nd March 1891, and 25th March to 31st March 1891.	None.	
Saugor Island . . .	1st April 1890 to 31st March 1891 . .	None.	

122. The solar and terrestrial observations were discontinued at all stations with the exception of Aden, Leh, Pachmarhi, Simla, Calcutta, Allahabad and Lahore from the 31st of December 1890, for the reasons given in para. 127 of last year's Administration Report. The observations taken during the nine months April to December 1890 were, it may be stated, as unsatisfactory as those of previous years, and utterly useless for the class of scientific investigation for which these observations were introduced.

123. Seismic instruments were supplied some years ago to the meteorological observatories at Sibsagar and Silchar at the instance of the Geological Survey of India for the purpose of earthquake observations. The chief objects of the apparatus supplied were to obtain a rough estimate of the intensity of the earthquake shock and of the direction of its advance. Unfortunately, the apparatus is not sensitive enough for the purposes for which it was devised, and has failed to register any of the numerous earthquakes which have been felt in Assam since its introduction.

STORM OBSERVATIONS.

124. The number of storm observations taken in the year 1890 was slightly greater than in the year 1889, and the observations, on the whole, were more carefully taken, and are hence more reliable and valuable. Very complete, useful and interesting observations were taken and sent in by the observers at Port Blair, Shortt's Island, Coconada and False Point of the most severe cyclonic storms which were experienced during the year at these stations. The observers at Akola, Allahabad, Belgaum, Berhampore, Burdwan, Cawnpore, Dhubri, Jessore, Jubbulpore, Lahore, Neemuch, Peshawar and Sibsagar sent in accurate and interesting information of the more important hot-weather storms which visited these stations. The majority of the remaining observations were nearly equal in point of value to the observations of these stations. The remainder were too brief to be of much use, and, as in the case of the single set of storm observations submitted by the Ajmere

and Bareilly observers, showed in some cases such a want of interest and judgment as to make them practically valueless. It will probably be found necessary in future years to reject such observations as of no value.

125. The amounts that have been awarded to each observer for the work of storm observations in 1890 are given below, and have been assigned in the same manner as last year. The amounts depend partly upon the number of series of storm observations taken, but chiefly upon the extent and value of the meteorological information sent in. In estimating the amounts the greatest importance has been attached to the extent and quality of the observations as complete records of the storms during which they were taken:—

PROVINCE.	Station.	Name of Observer.	Number of storm reports.	Amount.
				₹
BURMA	{ Akyab	J. J. Brown	2	5
	{ Diamond Island	W. Skinner	6	15
BAY ISLANDS	Port Blair	G. T. Carroll	5	60
BENGAL AND ASSAM	Balasore	Radha Mohun Dass	1	1
	Berhampore	Mahendra Nath Roy	2	6
	Burdwan	Makhodaprosad Roy Chowdhry	2	10
	Dhubri	Akhoy Coomar Sen	4	15
	False Point	W. B. Sparkes	1	15
	Fureedpore	Nares Chunder Mozoomdar	1	1
	Hazaribagh	Nathu Lal	1	4
	Jessore	Pareshnath Roy Chowdhri	1	5
	Mymensingh	Subal Chandra Saha	1	2
	Pedong	Father A. Desgodins, S. J.	2	40
	Pooree	M. Francis	2	15
	Saugor Island	{ J. A. Thomas	9	22
		{ A. E. F. Green	2	3
	Shortt's Island	W. Taskar	2	25
	Sibsagar	D. Barua	3	15
N.-W. PROVINCES AND OUDH.	Allahabad	Kedar Nath Chatterjee	14	60
	Bareilly	Gulzari Lal	1	1
	Cawnpore	C. La Porti	6	25
	Pithoragarh	Shersing	4	6
CENTRAL INDIA	{ Sutna	{ Harnath	21	36
		{ Hamta Pershad	3	4
	Neemuch	A. H. Garton	1	10
RAJPUTANA	{ Ajmere	{ Ram Pershad	1	1
	{ Jeypore	{ Doorga Pershad	9	20
	{ Mount Abu	{ M. M. Talati	18	60
PUNJAB	{ Delhi	{ Bansidhar	4	5
	{ Lahore	{ Jaspat Ray	23	60
	{ Ludhiana	{ Brij Lal	14	32
	{ Peshawar	{ Abdool Jabbar	5	15
	{ Sirsa	{ B. Gulzar Mahommed	11	25
CENTRAL PROVINCES	Hoshangabad	Behari Lal	5	10
	Jubbulpore	Sadhuram Dubay	9	45
	Khandwa	Rajaram Nanagi	4	10
	Nagpur	P. Soobiah	9	22
	Pachmarhi	A. Ranganaidcoovie	6	26
	Raipur	Govind Ram Chandra	2	8
	Saugor	Jadunath Basu	3	24
	Seoni	Punchum	19	60

PROVINCE.	Station.	Name of Observer.	Number of storm reports.	Amount.
				R
BOMBAY AND SIND .	Belgaum	R. D. Madurkar	1	5
	Bhuj	Samuel Solomon	32	50
	Deesa	G. P. Nesti	2	2
	Hyderabad	Satram Das Ramchand	11	30
	Jacobabad	Shaik Ali	3	5
	Karwar	G. W. M. D. Aranjo	5	8
	Malegaon	B. Doorganna	3	6
	Poona	V. B. Joshi	1	3
BERARS	Akola	Samuel Gregory	12	40
	Chikalda	P. Raja Rathnum Naidu	8	30
MADRAS	Coconada	C. Gaetane	4	30
	Cuddalore	K. Subramutty	4	7
	Gopalpur	T. Venkataramanish	3	6
	Madras (Port Office)	Narain Moorty Naidu	4	8
	Masulipatam	J. R. Gonsalves	6	15
	Nellore	T. Rajaram Row	4	20
	Negapatam	D. Conn	4	8
		E. R. Sathoo Row	3	9
EXTRA INDIAN	Baghdad	J. J. Nelson	1	2

126. It has recently been intimated to observers that a few complete and accurate series of observations of cloud movements and the kind and amount of cloud, and of the wet and dry-bulb thermometers during the more severe cold-weather cyclonic storms of Upper India, and observations at very short intervals of the wet and dry-bulb thermometers and of the cloud movements in the inner storm area and in the calm area (more especially) of cyclones, are greatly required, and would be very valuable and useful. Observers have also been requested to obtain, if possible, definite information of the extent of country over which any very severe thunder-storm or hail-storm extends, and its intensity in different parts of the storm area.

INSPECTION OF OBSERVATORIES.

127. The following table shows the amount of inspection done during the year :—

PROVINCE.	INSPECTED BY		
	Imperial Reporter.	Assistant or Provincial Reporter or Sanitary Commissioner.	Personal Assistant to the Imperial Reporter.
Bengal	Jessore	Mozufferpore	Mozufferpore.
	Krishnaghur	Gya	Gya.
		Bankipore	Bankipur.
		False Point	Rungpur.
		Pooree	Dinagepur.
		Ranigunj	Bogra.
			Rampur Bauleah.
			Purneah.
			Bhagulpur.
			Durbhanga.
			Motihari.
			Chupra.
			Arrah.
			Buxar.
			Krishnaghur.
			Jessore.

PROVINCE.	INSPECTED BY		
	Imperial Reporter.	Assistant or Provincial Reporter or Sanitary Commissioner.	Personal Assistant to the Imperial Reporter.
North-Western Provinces	Allahabad Jhansi Bareilly Agra . . . . .	.....	Ghazipur. Gorakhpur. Benares. Cawnpore, Agra.
Punjab	Mooltan Khushab Sirsa Lahore	Khushab. D. I. Khan Rawalpindi Peshawar Sialkot. Lahore.	Mooltan. Montgomery. Khushab.
Beluchistan . . . . .	.....	.....	Quetta.
Central India and Rajputana . . . . .	.....	.....	Ajmere. Sanibhar. Indore. Pachpadra. Neemuch.
Central Provinces	Nagpur. Pachmarhi Saugor Hoshangabad.	Raipur. Hoshangabad	Khandwa.
Berars	Amraoti.		
Bombay	Marmagao Sholapur.	.....	Veraval. Ratnagiri. Surat. Poona. Ahmednagar. Hyderabad. Rajkot. Jacobabad. Karachi. Malegaon.
Madras	Coimbatore Cuddapah Bangalore Secunderabad Bellary Madura Calicut	Gopalpore. Trichinopoly. Kurnool. Salem. Cuddalore. Nellore. Negapatam.	

128. The following observatories were satisfactory in every respect at the time of inspection :—

Lahore.
Allahabad.
Karachi.

Nagpur.
Peshawar.
False Point.

Hoshangabad.
Khandwa.

129. The following were also in very good order, and their observers doing their work satisfactorily :—

Province.	Observatories.	Province.	Observatories.
Bengal	{ Bankipore. Ranigunj. Jessore. Krishnaghur. Bogra. Rampur-Beauleah. Purneah. Bhagulpur. Motihari. Chupra. Buxar. Arrah.	Central Provinces	{ Hoshangabad. Jubbulpore. Khandwa. Saugor. Raipur.
North-Western Provinces	{ Agra. Cawnpore. Gorakhpur. Benares.	Sind	{ Hyderabad. Jacobabad.
Punjab	{ Rawalpindi. Montgomery. Sirsa. Mooltan.	Bombay	{ Ratnagiri. Poona. Sholapur. Ahmednagar. Malegaon.
Central India and Raj-putana	{ Neemuch. Indore. Sambhar.	Madras	{ Trichinopoly. Kurnool. Salem. Coimbatore. Cuddapah. Bangalore. Bellary. Madura. Nellore. Cuddalore. Gopalpore.

130. The following observatories were in a fairly satisfactory condition, but their observers were found to be more or less careless in keeping their instruments in good order, and the sheds neat and tidy :—

Province.	Observatories.	Province.	Observatories.
Bengal	{ Gya. Mozufferpore. Rungpur. Dinagepur.	Central Provinces	Pachmarhi.
North-Western Provinces	{ Bareilly. Jhansi.	Berar	Amraoti.
Punjab	{ Sialkot.	Madras	Secunderabad.
		Bombay	Surat.
		Beluchistan	Quetta.

131. The following gives extracts from the inspection reports of Dera Ismail Khan, Durbhunga, Rajkot, Mozufferpore, Veraval, Pachpadra, Pooree and Quetta, all of which were found to be in a very unsatisfactory condition at the time of inspection :—

Dera Ismail Khan.—Mr. Dallas, who inspected the observatory, states that the shed was in a disgraceful state, and the observer had taken no trouble to report its condition. The wet-bulb thermometer was much encrusted. The wet minimum was cleaned, but it was found impossible to clean the wet hygrometer properly, as it was thickly encrusted, and it was necessary to replace it by a new instrument. The observer is careless, and takes no interest in his work.

Durbhunga.—Lala Hem Raj, my Personal Assistant, who inspected the observatory, states :—“ All the instruments, with the exception of the barometer, were very filthy, and,

at least, two of the instruments in consequence were unfit for use." He also found that the observer, instead of taking the observations himself, was employing a substitute who was unable to read the instruments correctly. The 8-A.M. readings of the barometer, thermometers and wind vane taken by this substitute, on the morning of the inspection, were all more or less erroneous. So far as could be ascertained, the observer latterly had rarely taken the 8-A.M. observations himself. The condition of the observatory was a disgrace to the observer. The observer's allowance was in consequence suspended, and the circumstances reported to his departmental superior in order that steps might be taken to obtain trustworthy observations from the Durbhunga observatory.

Rajkot.—Was inspected by my Personal Assistant. The shed was dirty, the hygrometers dirty and out of order, and the anemometer in a filthy condition. As this is the second time this observatory has been found to be in this dirty condition when inspected, the observer was fined and warned.

Mozufferpore.—This observatory, which was opened in April, was inspected in November by Lala Hem Raj. The wet-bulb thermometers were dirty and thickly encrusted, the minimum in shade was out of order and the anemometer very dirty. The rain-gauge, instead of being in its proper position, was found under the observer's office table. The instruments were thoroughly cleaned, and the observatory put in proper condition, and the observer was afterwards warned to be more careful about his instruments.

Veraval.—This observatory was established in 1889 to afford information of the weather on the Kathiawar coast. The observations during the months of June to September 1890 were very inaccurate and misleading. Lala Hem Raj was hence sent to inspect the observatory and to remedy any defects in the instruments, and to teach the observer how to read the instruments correctly. The postmaster was observer at the time. The thermometers were found to be exceedingly dirty. The column of the minimum thermometer was detached in many fragments, and the instrument was utterly useless in its then condition. The index of the wet minimum was lying outside the spirit in the upper part of the tube. The anemometer was covered with dirt and oil and the pointers were found to be cemented together by the oil and dust. The wind vane was partially broken and needed repairs. The observer, when he heard of the intended visit of the Personal Assistant, had covered all his instruments, including the outer brass tube of the barometer, with a thick coating of rancid native oil. The instrument was hence in the most filthy condition. The observer was unable to read either the barometer, thermometers or rain-gauge correctly. The Personal Assistant spent a couple of days in endeavouring to teach him, but without any useful result. He then communicated to me by telegraph, and I authorized him to teach the telegraph signaller the work, and to appoint him to act temporarily as observer. The telegraph signaller learnt the work rapidly and satisfactorily. As the observations since he took up the work have accorded with those of neighbouring stations, he has recently been permanently appointed as observer.

Pachpadra.—Was inspected in September 1888 by Mr. Dallas, and was found to be in a very unsatisfactory condition. Certain changes were then made which it was hoped would place it on a proper footing. The improvement only lasted for a short time, after which the observatory became even worse than before. The observer was warned and fined on more than one occasion, but without effecting any permanent improvement. Lala Hem Raj was hence instructed to visit and inspect it very carefully. The following

is a summary of his report :—" The barometer was in fair order, the dry-bulb thermometer was dirty, the wet-bulb thermometer very dirty and slightly encrusted and perfectly dry, and there was no water in the receiver ; and there had apparently been none for many days. The wet bulb was hence acting as a dry bulb. The maximum and minimum thermometers were dirty. Hence the condition of the instruments was far from satisfactory. The observer was apparently unable to read the instruments accurately, and, in some cases, as in the maximum and minimum thermometers, he read them by wrong methods. Also, so far as the Personal Assistant could ascertain by careful enquiry, the observer was extremely unpunctual in the performance of his meteorological duties, and rarely ever took them at the correct time. The observations for several months previous had hence been utterly worthless. Fresh arrangements have since been made for the work of observation through the assistance of the Assistant Commissioner, Northern India Salt Revenue, who has taken much interest in the observatory.

Poorce.—Mr. Little, who inspected the observatory, reported as follows :—" The observer knows how to read the instruments, but is evidently very lax in the execution of his duties. As the wind instruments were so far from his home, he had trained a chuprasi to take the readings, and this man appeared to be doing the work daily, receiving from the observer Rs. 2 a month. He may also at times have read the thermometers, as he explained that at 8 A.M. that morning the cloth of the wet-bulb thermometer was entire, and had since been torn by crows. The rain-gauge bottle was an inch full of sand, which was caked at the bottom, probably by the rain water, which should have been registered. The observatory was in a disgraceful condition, and the observer very much in want of supervision."

Quetta.—This observatory had not been inspected for some years, and, as too frequently happens in such cases, the observer had fallen into careless habits and neglected his instruments. The wet-bulb thermometers were thickly encrusted, the spirit column of the minimum thermometer was broken into a number of detached portions and the instrument was consequently utterly useless. The anemometer was very dirty and out of order, and had to be replaced by a new instrument, which was ordered by telegram from Calcutta. The observer read the instruments correctly, but apparently takes very little interest in his meteorological work.

METEOROLOGICAL OFFICES.

132. The Calcutta branch of the India Meteorological office and the Bengal Meteorological office now form a single office, which is the Central Office for the Meteorological Department. The Simla branch of the India Meteorological office carries out an increasing amount of the work of tabulation in consequence of the additions made to the list of observatories contributing weather telegrams for publication in the India Daily Weather Report. In addition to these offices, there are provincial meteorological offices at Bombay, Allahabad and Madras. The work of tabulation of certain meteorological registers was discontinued at Allahabad from January 1890, and the office rearranged in such a manner as to enable Mr. Hill to utilize it chiefly for the preparation of data for certain investigations that it was proposed he should take up. The clerks were engaged in preparing data in connection with the rainfall of the North-Western Provinces at the time of Mr. Hill's

death, and were shortly afterwards transferred to Calcutta, where their services could be better utilized.

133. The following table gives a list of the number of ministerial officers and menial servants in the several meteorological offices at the end of the year 1890-91 :—

	INDIA AND BENGAL.		North-Western Provinces.	Western India.	Madras.	Total.
	Calcutta.	Simla.				
Head clerks	1	1	...	1	1	4
Computers	2	1	...	...	...	3
Clerks and copyists	8	...	...	...	2	10
Tabulators	26	13†	1	9(a)	...	49
Draughtsmen	3	3	...	1 (b)	...	7
Artisans	3*	...	...	...	...	3
Peons and menials	14†	9	2	6 (c)	2	33

(a) Three of these are paid from contributions of the Bombay Port Trust and Chamber of Commerce for the Bombay Daily Report.

(b) Paid from contribution of the Bombay Port Trust and Chamber of Commerce for the Bombay Daily Report.

(c) Four of these are paid from contribution of the Bombay Chamber of Commerce for the Bombay Daily Report.

* Paid from subscriptions to Bay of Bengal Daily Weather Report.

† Two of these are paid from subscriptions to Bay of Bengal Daily Weather Report.

‡ Including one actinometric observer.

134. The following table states the monthly number of registers of observations reduced and tabulated in the several meteorological offices during the year 1890-91 :—

PROVINCE.	CALCUTTA.		SIMLA.	BOMBAY.	MADRAS.
	8-h. register.	10-h. & 16-h. register.	8-h. register.	10-h. & 16-h. register.	10-h. & 16-h. register.
Bengal and Assam	49	18	...	...	...
North-Western Provinces and Oudh . . . . .	...	8	13	...	...
Punjab . . . . .	...	6	13	...	...
Sind, Cutch, Guzerat	1	1	5	2	...
Rajputana and Central India	4	3	8	1	...
Central Provinces . . . . .	...	11	8	...	...
Berar . . . . .	...	1	2	3	...
Bombay . . . . .	...	1	10	6	...
Madras, Mysore, and Coorg	3	1	21	...	7
Burma	1	4	11	...	...
Bay Islands	1	2	...	...	...
Extra Indian	4	5	1	...	...
TOTAL	63	61	92	12	7

135. The departmental observatories of Calcutta (Alipore), Allahabad, Lahore and Simla, and the non-departmental observatories of Madras, Jeypore and Ghazipur, which send their observations into the Calcutta Meteorological office fully reduced and tabulated, are not included in the above list. Those received from the non-departmental observatories at Bombay, Madras and Vizagapatam require partial reduction and slight re-arrangement in the Calcutta office. The observations sent in by all voluntary observatories are submitted on forms supplied by the department, and are reduced in the meteorological offices.

136. The chief duties of the various Meteorological offices were stated in last year's Administration Report (paras. 136-139) and need not be repeated. No important change was made in any of the offices except the Allahabad office.

137. The Government of India sanctioned several changes in the Allahabad office, which took effect in April 1890. By these changes the work of reducing and tabulating the observations of the observatories in the North-Western Provinces, Oudh, and Rajputana was transferred from the Allahabad to the Calcutta office. It was further arranged that the Allahabad office should be chiefly utilized to assist Mr. Hill in carrying out special investigations in meteorology, as arranged for between himself and the Imperial Reporter. These changes permitted some reduction to be made in the strength of the Allahabad office. The head clerk, Babu Chintamony Ghosh, retired on pension, and the second clerk, Babu Kali Prasanna Datta, was transferred to the Calcutta office. Babu Kedar Nath Chatterjee, head observer of the Allahabad Observatory, was appointed to act as head clerk. Mr. Hill's death necessitated a revision of the arrangements in the Allahabad office. It was considered desirable under the altered circumstances to make proposals for the modification of the work of the North-Western Provinces' Reporter; but as these require the sanction of the Secretary of State, there has been considerable delay in the settlement of the matter, and in the appointment of a successor to Mr. Hill, and the whole subject is yet under consideration. Meanwhile, as the two tabulators retained in the Allahabad office to assist Mr. Hill in his special investigations were left without work by his death, they were employed for some time in tabulating rainfall data, and were finally allowed to obtain employment elsewhere.

138. Messrs. Pedler and Little have performed the storm warning duties of the Bay of Bengal storm signal service and Mr. Dallas the work of the Bombay or west coast of India storm warning service successfully and satisfactorily during the present year, and have co-operated heartily with me in carrying out the various minor improvements that have been made in the working of the Department during the year.

139. Mr. Hutchinson and his Head Clerk, Mr. Ganesh Shadashiv, deserve credit for the manner in which the daily report has been improved during the year to meet the requirements of the Bombay commercial public.

140. Babu Fanindra Mohun Basu, Head Clerk of the combined India and Bengal Office at Calcutta, has arranged and controlled the work of the Office with the same judgment, firmness and ability that he has shown during the whole of his service in the Department.

141. Lala Hem Raj, as I have already pointed out, has rendered excellent service in the work of inspecting observatories. He has also been of great assistance to me in the Simla office and is a hard-working, energetic and useful Assistant.

142. The provincial Reporters report favourably of the work of their respective

offices. The following subordinates may be especially mentioned as having done excellent work during the year :—

Babu Nirduksha Kumar Ghosh	.	.	.	Chief Computer, Calcutta Office.
" Brojo Mohun Ruckhit, B.A.	.	.	.	Chief Observer, Alipore Observatory.
" Amar Singh	.	.	.	Computer, Simla Office.
" Jaspat Rai	.	.	.	Chief Observer, Lahore Observatory.
" Kedar Nath Chatterjee	.	.	.	Chief Observer and Head Clerk, Allahabad Observatory.
" Nirbhai Sing	.	.	.	Actinometric Observer, Simla Office.

INSTRUMENTS.

143. The following table gives the return of the instruments in store at the beginning and end of the year, and of those received and issued by the Calcutta Meteorological office during the year to meteorological observatories and offices :—

Return of the Stock, Receipt, and Issue of Instruments for the year 1890-91.

INSTRUMENTS.	In store, 1st April 1890.	Received, 1890-91.	Issued, 1890-91.	In store on 31st March 1891.
Barometers, observatory, Fortin's principle	29	28	35	22
" " Kew "	6	8	5	9
" mountain portable tripod (Adie)	30	3	5	28
" marine, Kew principle	24	1	1	24
" Negretti and Zambra (special make)	7	3	5	5
" aneroid	10	9	11	8
Hick's barograph	1	...	...	1
Thermometers, standard, with attached scales	36	...	1	35
" " without " "	10	2	2	10
" for hygrometers (Kew pattern)	67	45	59	53
" maximum for shade	92	12	61	43
" solar <i>in vacuo</i> (self-registering)	31	11	25	17
" " " (non-self-registering)	37	...	...	37
" " not <i>in vacuo</i>	2	...	...	2
" minimum for shade	65	57	76	46
" " for radiation	27	11	10	28
Sling thermometers	14	...	...	14
Chemical "	7	...	1	6
Six's "	7	...	...	7
Common "	1	...	...	1
Traveller's maximum and minimum thermometers, in pairs	5	...	...	5
Frankland's sun thermometers	3	...	...	3
Boiling-point thermometers	11	...	...	11

Return of the Stock, Receipt, and Issue of Instruments for the year 1890-91—continued.

INSTRUMENTS.	In store, 1st April 1890.	Received, 1890-91.	Issued, 1890-91.	In store on 31st March 1891.
Thermograph with Negretti and Zambra's set of recording thermometers.	1	...	...	1
Negretti and Zambra's set of recording thermometers . .	1	...	...	1
Pouillet's pyrheliometer	1	...	...	1
Thermometers for Stewart's actinometers	7	...	...	7
Stewart's actinometer	1	...	...	1
Hodgkinson's actinometers	2	...	...	2
Herschell's actinometer	1	...	...	1
Regnault's hygrometers	3	...	...	3
Daniell's „	11	1	...	12
Halleur's „	5	...	...	5
Pocket spectroscope (Browning's)	1	...	...	1
Anemometers	56	41	25	72
Wind-vanes	21	...	10	11
Casella's anemograph . . . . .	...	1	1	...
Beckley's „ . . . . .	...	1	1	...
Electrical anemometers and wind-vanes	3	...	...	3
Rain-gauges (Symons'), 5" diameter	52	29	38	43
„ („), 6" „	3	1	1	3
„ („), 8" „	4	2	...	6
Measure-glasses for 5" rain-gauges	170	1	24	147
„ „ for 6" „	10	1	2	9
„ „ for 8" „	3	...	...	3
Reading lenses	8	6	9	5
Sun thermometer-stands	19	1	1	19
Woollen pads for Grass Radiation thermometers	14	1	5	10
Barometer cages	2	12	5	9
Thermometer cages	9	6	13	2
„ „ for ships	16	...	...	16
Prismatic compasses	2	...	...	2
Magnetic compasses	5	...	3	2
Sand-glasses (3-minute)	67	1	30	38
Sundials	3	...	...	3
Watches	26	21	31	16
Bottles for wet-bulb thermometers	74	...	17	57
Electrophorus	1	...	...	1

Return of the Stock, Receipt, and Issue of Instruments for the year 1890-91—concluded.

INSTRUMENTS.	In store, 1st April 1890.	Received, 1890-91.	Issued, 1890-91.	In store on 31st March 1891.
Filled tubes for marine Kew-principle barometers . . .	...	15	...	15
„ „ „ observatory Kew-principle barometers . .	14	...	2	12
„ „ „ Adie's barometers	4	...	...	4
„ „ „ Negretti and Zambra's barometers . .	1	...	...	1
Chain for Casella's embossing anemograph	94 ft.	...	...	94 ft.
Gauges for testing Symons' 5" rain-gauges	2 pairs	1 pair	1 pair	2 pairs
Plummet	1	...	1	...
Bull's-eye lanterns	5	...	4	1
Bed-plates for anemometers	17	...	...	17
Hydrometer	1	...	...	1
Air-meters	4	...	...	4
Traveller's anemometer	1	...	...	1
Measuring tape	1	...	...	1
Spirit levels	2	...	...	2
Declinometer	1	...	...	1
Sunshine-recorder	1	...	...	1
Draper's self-recording thermometer	1	...	1	...
Back-boards for barometers . . . . .	...	12	...	12
Glass cisterns for Fortin's barometer . . . . .	...	10	2	8

LIBRARY.

144. Appendix A gives a list of the additions to the Library during the past year. It is in good order. Appendix B gives a list of the Government officials, libraries, foreign observatories and societies, &c., to which the publications of the India Meteorological Department are supplied.

JOHN ELIOT,
Meteorological Reporter
to the Government of India.

METEOROLOGICAL OFFICE, CALCUTTA, }
The 1st August 1891.

APPENDIX A.

Presentations to the Library from the 1st April 1890 to the 31st March 1891.

Place.	Donor.	Title of Work.
ADELAIDE . . .	Government Astronomer .	Report on the telegraphic determination of Australian longitudes. Rainfall in South Australia and the northern territory during 1887, with weather characteristics of each month. Meteorological observations made at the Adelaide observatory and other places in South Australia and the northern territory during the years 1883 and 1888.
ALGERIA . . .	Meteorological Service .	Bulletin Météorologique du Gouvernement Général de l'Algérie, January 1890 to January 1891. Bulletin Mensuel, January 1889.
	Government of the North-Western Provinces and Oudh.	Report by the Board of Revenue on the Revenue Administration of the North-Western Provinces for the revenue year ending 30th September 1889. Report on the progress and condition of the Government Botanical Gardens, Saharanpur and Mussooree, for the year ending 31st March 1890. Report on the Horticultural Gardens, Lucknow, for the year ending 31st March 1890. Report on the Cawnpore experimental station for the Kharif and Rabi seasons, 1889-90.
ALLAHABAD . .	Land Records and Agriculture Office.	Final forecast of the Wheat crop of 1889-90. Final forecast of the Linseed and Rapeseed crop of 1889-90. Final forecast of the Indigo crop for 1890. Second forecast of the Cotton crop of 1890-91. Second forecast of the Wheat crop for 1890-91. Second forecast of the Linseed and Rapeseed crop of 1890-91.
	Meteorological Office .	Brief sketch of the meteorology of the North-Western Provinces and Oudh and adjacent parts of Rajputana and the Punjab for the year 1889. Jaarboek, 1889.
AMSTERDAM . .	Royal Academy of Sciences .	Verslagen en Mededeelingen, Afd. Natuurkunde, 3e. Reeks, Deels VI and VII. Magnetic survey of the eastern part of Brazil by Dr. Van Ryckevorsel and E. Engelenburg.
	Royal Dutch Meteorological Institute.	An attempt to compare the instruments used for absolute magnetic measurements at different observatories.
BANGALORE . .	Chief Commissioner of Coorg .	Report on the administration of Coorg for 1889-90.
BATAVIA . . .	Magnetical and Meteorological Observatory.	Observations made at the Magnetical and Meteorological Observatory at Batavia, Vol. XII, 1889. Rainfall in the East Indian Archipelago for 1889.
	Gesellschaft für Erdkunde .	Verhandlungen, Band XVII, Nos. 2 to 10, and Band XVIII, No. 1. Mittheilungen von Forschungsreisenden und Gelehrten aus den Deutschen Schutzgebieten, parts 1 to 3 of volume III. Zeitschrift der Gesellschaft für Erdkunde Nos. 144 to 149, and Band XXVI, No. 1.
BERLIN . . .	German and Austrian Meteorological Society.	Meteorologische Zeitschrift, March 1890 to February 1891. Ergebnisse der Meteorologischen Beobachtungen im Jahre 1890, Heft 1.
	K. Preussische Meteorologische Institut.	Das Königliche Preussische Meteorologische Institut in Berlin und dessen observatorium bei Potsdam. Abhandlungen des Königlich Preussischen Meteorologischen Instituts, Band I, Nos. 1 to 3.

Presentations to the Library from the 1st April 1890 to the 31st March 1891—continued.

Place.	Donor.	Title of Works.
BERNE . . .	Dept. de l'Interieur de la Confederation Suisse	Tableau graphique des températures de l'air et des hauteurs pluviales pour le Bassin du Rhin, pour le Bassin de l'Aar, pour les Bassins de la Reuss, Limmat, du Rhône, du Tessin et de l'Inn, July to December 1889. Graphische Darstellung der Schweizerischen hydrometrischen Beobachtungen über das Rheingebiet, Aaregebiet, Reussgebiet, Limmatgebiet, Rhônegebiet und Tessingebiet, January to June 1890.
	Government of Bombay . .	Twenty-sixth Annual Report of the Sanitary Commissioner for the Government of Bombay for 1889.
	Government Observatory . .	Magnetical and meteorological observations made at the Government Observatory, Bombay, during 1888-89. Preventives against the attacks of Weevil upon corn and grain.
BOMBAY . . .	Land Records and Agriculture Office.	Annual Report of the Khandesh Experimental Farm for the year ending 31st March 1890. Crop experiments, Bombay Presidency, 1889-90. Annual Report of the Director, Land Records and Agriculture, Bombay Presidency, for the year 1889-90.
	Meteorological Office . .	Brief sketch of the meteorology of the Bombay Presidency for 1889-90.
BRISBANE . . .	Meteorological Observatory . .	Weather chart of Australasia at 9 A.M. for 20th to 31st December 1889 and 2nd January to 11th February 1890.
BUDAPESTH . .	Central Anstalt für meteorologie und Erdmagnetismus.	Jahrbuch, XVII Band, Jahrgang, 1887.
CAIRO . . .	Egyptian Statistical Bureau . .	Bulletin Hebdomadaire Nos. 10 to 37 of 1890. Civil Budget Estimate for the year 1890-91. Civil Estimates for 1890-91.
	Comptroller and Auditor General.	History of Services of Officers holding gazetted appointments under the Government of India in the Home, Foreign, Revenue and Agricultural, and Legislative Departments corrected to 1st July 1890.
	Director General of Post Offices .	Indian Postal Guide, April and October 1890.
	Director General of Telegraphs .	Indian Telegraph Guide, April and October 1890.
	Geological Survey of India . .	Records of the Geological Survey of India, Vol. XXIII, Parts 2 to 4. Contents and Index of the first twenty volumes of the Records of the Geological Survey of India. Memoirs of the Geological Survey of India, Vol. XXIV, Part 3.
CALCUTTA . . .		Bengal Quarterly Civil List, 1st April 1890, 1st July 1890, 1st October 1890, and 1st January 1891. First Triennial Report of the Sanitary Commissioner for Bengal on the working of the Vaccination Department in Bengal, during the years 1887-88, 1888-89, and 1889-90. General Report on Public Instruction in Bengal for 1889-90. Resolution reviewing the Reports on the working of the District Boards in Bengal during the year 1889-90. Report on the Administration of Bengal during 1889-90. Report on the external trade of Bengal with Nepal, Tibet, Sikkim and Bhutan for the year 1889-90. Report on the rail-borne traffic of Bengal during the year 1889-90. Report on the river-borne traffic of the Lower Provinces of Bengal and on the inland trade of Calcutta and on the trade of Chittagong and the Orissa Ports for the year 1889-90. Returns of the rail and river-borne trade of Bengal during the quarter ending 30th September 1890. Returns of the rail-borne trade of Bengal for the quarter ending 31st December 1889, 31st March and 30th June 1890.

Presentations to the Library from the 1st April 1890 to the 31st March 1891—continued.

Place.	Donor.	Title of Works.	6
CALCUTTA— <i>contd.</i>	Government of Bengal— <i>contd.</i>	Revenue Report of the Public Works Department, Irrigation Branch, Bengal, for the year 1889-90.	
		Tables for the transliteration of Burmese into English.	
		The Climates and Weather of India, Ceylon and Burma by H. F. Blanford.	
		Twenty-second Annual Report of the Sanitary Commissioner for Bengal, 1889.	
	Government of India, Home Department.	List of Civil Officers holding gazetted appointments under the Government of India in the Home, Legislative, Foreign, and Revenue and Agricultural Departments corrected to 1st January 1890 and 1st July 1890.	
		Instructions for rainfall observers of the United States Geological Survey for 1889.	
		India Office List for 1890.	
	Government of India, Revenue and Agricultural Department.	Tables for transliteration of Burmese into English.	
		Administration Report of the Indian Marine for the official year 1889-90.	
		List of Officers in the Survey Department and in the offices of the Meteorological Reporter to the Government of India, Trustees of the Indian Museum, Reporter on Economic Products, Director of the Botanical Department, Northern India, and General Superintendent Horse Breeding Department corrected to 1st July 1890.	
	Indian Association for the Cultivation of Science.	Report of the 13th Annual Meeting of the Indian Association for the Cultivation of Science held in March 1890.	
		Report on the laying of the foundation-stone of the Vizianagram Laboratory of the Indian Association for the Cultivation of Science on 27th March 1890.	
	John Eliot, Esq.	On the occasional inversion of the temperature relations between the hills and plains of Northern India.	
	Pat Doyle, Esq.	Indian Engineering, Vol. VII, Nos. 14 to 26; Vol. VIII, Nos. 1 to 26; Vol. IX, Nos. 1 to 13.	
	Surveyor General of India	Account of the Operations of the Great Trigonometrical Survey of India, Vols. XI, XII, and XIII.	
		General Report on the Operations of the Survey of India Department for the year 1888-89.	
CARLSRUHE	Central Bureau für Meteorologie und Hydrographie.	Deutsches Meteorologisches Jahrbuch für 1889.	
CHEMNITZ	Royal Meteorological Institute	Jahrbuch für 1888, II Hälfte, Abtheilung III; and for 1889, I Hälfte, Abtheilung I and II.	
CHRISTIANIA	Norwegian Meteorological Institute.	Jahrbuch des Norwegischen Meteorologischen Instituts für 1888.	
		Oversigt over Luftens Temperatur og Nedbøren i Norge i Aaret for 1888 and 1889.	
COIMBRA	Observatorio Meteorologico E. Magnetico.	Observações Meteorologicas, Anno de 1877 to 1885, and 1889.	
COLOMBO	Surveyor General of Ceylon	Administration Report, 1889, Part II, Scientific—Meteorology.	
COPENHAGEN	Institut Meteorologique Danois	Bulletin Météorologique du Nord, February 1890 to January 1891.	
		Annuaire Météorologique pour l'année 1885, Part II; 1886, Parts I to III; 1887, Parts I to III; and 1888, Parts I and III.	
	Royal Academy of Sciences	Oversigt, Nos. 3 of 1889 and 1 and 2 of 1890.	
CORDOBA	Instituto Geografico Argentino	Boletin del Instituto Geografico Argentino, Tomo X, Nos. 10, 11, 12; Tomo XI, Nos. 1, 2, 3.	
	Meteorological Office	Anales de la Oficina Meteorológica Argentina, Tomo VII.	
COSTA RICA	Instituto Fisico-Geografico Nacional.	Anales del Instituto Fisico-Geografico Nacional de Costa Rica Tomo II, Parte I.	
DEHRA DUN	Trigonometrical Branch, Survey of India.	Spirit-levelled heights No. 5, Madras Presidency, Season 1888-89.	
DORPAT	Observatory	Observations for July to December and year 1881, January to December and year 1882, January to December, and year 1883, June to December 1888.	

Presentations to the Library from the 1st April 1890 to the 31st March 1891—continued.

Place.	Donor.	Title of Works.
DORPAT . . .	Dr. Karl Weihranch . . .	Fortsetzung der neuen untersuchungen über die Bessel'sche Formel und deren verwendung in der Meteorologie.
DUBLIN . . .	Royal Dublin Society . . .	Scientific Proceedings, Vol. VI, Nos. 7 to 9.
EDINBURGH . . .	Scottish Meteorological Society .	Journal of the Scottish Meteorological Society with tables for the year 1889.
GREENWICH . . .	Royal Observatory . . .	Magnetical and Meteorological observations for 1887, with Appendix I. Aus dem Archiv der Deutschen Seewarte, XII. Jahrgang, 1889. Deutsche Ueberseische Meteorologische Beobachtungen, Heft III. Die Ergebnisse der Wetterprognosen im Jahre 1889.
HAMBURG . . .	Deutsche Seewarte . . .	Ergebnisse der Meteorologischen Beobachtungen in Deutschland, Jahrgang XI, 1888; and XII, 1889. Ergebnisse der Sturmwarnungen im Jahre 1889. Monatsbericht der Deutschen Seewarte for November to December 1889, and January to August 1890. Wetterbericht 1st March 1890 to 28th February 1891.
IRKUTSK . . .	E. Stelling . . .	Résumé der magnetischen und meteorologischen beobachtungen des Irkutsker observatoriums für 1888. Magnetische beobachtungen im Lena-Gebiet im Sommer 1888.
LAHORE . . .	Government of the Punjab.	Report on the Land Revenue Administration of the Punjab for the Agricultural year 1st October 1888 to 30th September 1889. Report on the meteorology of the Punjab for the year 1889-90. Hoshiarpur settlement report, 1879-84, and maps. Report on the revised settlement of the Gurgaon District, 1872-83. Report on the Settlement of the Barak Tappa of the Tere Tahsil, Kohat District, 1883 to 1887. Final Report on the revision of settlement of the Ludhiana District, 1878 to 1883. Maps to accompany the settlement report of the Ludhiana District.
LEIPZIG . . .	Vereins für Erdkunde . . .	Mitteilungen des vereins für Erdkunde zu Leipzig, 1889.
LEYDEN . . .	Observatory . . .	Annalen der Sternwarte in Leiden, Bands V and VI.
LISBON . . .	Observatorio do Infante D. Luiz	Annaes do observatorio do Infante D. Luiz, Volume XXV, 1887.
	G. J. Symons, Esq. . . .	Symons's Monthly Meteorological Magazine for March 1890 to February 1891.
	J. J. Hicks, Esq. . . .	Catalogue of meteorological and scientific instruments.
	Kew Observatory . . .	Report of the Kew Committee for the year ending 31st October 1890. A brief notice respecting photography in relation to meteorological work by G. M. Whipple.
	L. Casella, Esq. . . .	Catalogue of scientific instruments.
LONDON . . .	Meteorological Office . . .	Report of the Meteorological Council to the Royal Society for the year ending 31st March 1889. Bulletin International Bureau Central Meteorologique de France, Paris, for 1889. Meteorological observations at the Foreign and Colonial stations of the Royal Engineers and Army Medical Department for the years 1852 to 1886. Summary of the observations made at the stations included in the daily and weekly Weather Reports for April to December 1888, August 1889 to March 1890. Quarterly Summary of the Weekly Weather Report for October to December 1889, and January to June 1890. Summary of the Weekly Weather Report for the year 1889.

Presentations to the Library from the 1st April 1890 to the 31st March 1891—continued.

Place.	Donor.	Title of Works.
LONDON— <i>contd.</i>	Meteorological Office— <i>contd.</i>	Weekly Weather Report, Volume VII, Nos. 1—39. Daily Weather Reports for 1st July to 31st December 1889. Quarterly Weather Report, Part II, April to June 1880. Meteorological observations made at Sanchez (Samana Bay), St. Domingo, for 1886-88.
	R. H. Scott, F. R. S.	The variability of the temperature of the British Isles, 1869—1883 inclusive.
	Royal Geographical Society	Proceedings of the Royal Geographical Society and Monthly Record of Geography, Vols. I to XII, Vol. XIII, Nos. 1 and 2. Supplementary papers, Vols. I and II, Vol. III, Part I.
	Royal Meteorological Society	Quarterly Journal, Vol. XVI, Nos. 73 to 76. Meteorological Record, Vol. IX, Nos. 35 & 36, Vol. X, No. 37.
	Royal Society	Proceedings, Vol. XLIV, No. 269, Vol. XLVI, No. 285, Vol. XLVII, Nos. 286 to 293, Vol. XLVIII, Nos. 294 and 295.
	Society of Arts	Journal, Nos. 1947 to 1998.
	Editor	The Madras Christian College Magazine for October 1890.
MADRAS	Board of Revenue	Weekly abstract of season reports for the weeks ending 22nd March 1890 to 14th March 1891. Madras Land Revenue Reports for Fasli $\frac{1297}{1887-88}$, $\frac{1298}{1888-89}$. Annual Reports of Forest Department, Madras Presidency, 1888-89. Annual Administration Reports of the Forest Department, Madras Presidency, for 1889-90.
MADRID	Observatory	Resumen de las observaciones Meteorologicas de Provincias, 1886. Observaciones Meteorologicas, Años, 1888 y 1889.
MAGDEBURGH	Magdeburgische Zeitung	Jahrbuch der Meteorologischen Beobachtungen der Wetterwarte der Magdeburgischen Zeitung, Jahrgang IX, 1889.
MANCHESTER	Literary and Philosophical Society.	Memoirs and Proceedings, 4th Series, Vol. III, Vol. IV, Nos. 1 and 2.
MANILA	Meteorological Observatory.	Observaciones Magnéticas verificadas por el P. Martin Juan en la Paragua Joló y Mindanao, Año 1888. Observaciones verificadas, January to July 1890.
MARSEILLE	Commission Meteorologique du Département des Bouches-du-Rhône.	Bulletin Annuel de la Commission de Météorologie du Département des Bouches-du-Rhône, Année 1888.
MAURITIUS	Royal Alfred Observatory	Meteorological results for 1889. Annual Report of the Director of the Royal Alfred Observatory for the year 1888.
MELBOURNE	Observatory	Monthly record of results of observations in meteorology, terrestrial magnetism, &c., taken at the Melbourne Observatory, October 1889 to September 1890.
MEXICO	Central Meteorological and Magnetical Observatory.	Boletín Mensual, Vol. II, Nos. 3 to 12. Estudios de meteorología comparada por Mariano Bárcena y Miguel Pérez, Vol. I. Gaceta Médico-Militar, Nos. 7 to 19.
	Sociedad Científica "Antonio Alzate."	Resumen comparativo correspondiente a los años de 1877 to 1888. Memorias de la Sociedad Científica "Antonio Alzate," Vol. III, Nos. 7 to 12. Memorias y Revista de la Sociedad Científica "Antonio Alzate," Vol. IV, Nos. 1 to 4.
	R. Osservatorio Astronomico di Brera.	Osservazioni meteorologiche eseguite nell' anno 1889. Pubblicazioni del Reale Osservatorio di Brera in Milano, Nos. I to V, VII, Parts 1 and 3, VIII to XV, XIX, XXII, XXXVI, and XXXVII.
MILAN		

Presentations to the Library from the 1st April 1890 to the 31st March 1891—continued.

Place.	Donor.	Title of Works.
MONTE VIDEO . . .	Observatorio Meteorologico del Colegio Pio de Villa Colon.	Boletin Mensual, Ano II, Nos. 3 and 4, 6 to 12.
MONTSOURIS (PARIS) . . .	Observatoire Municipal . . .	Annuaire de l' observatoire Municipal de Montsonris pour l' An 1890.
	Geographical Society . . .	Jahresbericht der Geographischen Gesellschaft in München für 1888 und 1889.
	Meteorological Central station	Uebersicht über die witterungsverhältnisse im Königreich Bayern, February 1890 to January 1891.
MUNICH . . .		Beobachtungen der meteorologischen stationen im Königreich Bayern, Vol. XI, Part 4, Vol. XII, Parts I to III.
		Georg Simon Ohm's wissenschaftliche leistungen.
		Ueber die molekular bes chaffenheit der crystalle.
	Royal Bavarian Academy of Sciences.	Sitzungsberichte der mathematisch-physikalischen classe der K. B. Akademi der wissenschaften, 1888, Part III, and 1889, Parts I and II.
		Abhandlungen der Mathematisch-Physikalischen classe der K. B. Akademie der wissenschaften, Vol. XVII, Part I.
		Resolution on the Revenue Administration of the Central Provinces for the year 1888-89.
		Resolution on the management by Government of private estates in the Central Provinces for the revenue year ending the 30th September 1889.
		Returns of rail-borne Trade of the Central Provinces for the quarters ending 31st March, 30th June, and 30th September 1890.
NAGPUR . . .	Chief Commissioner, Central Provinces.	Report on the Nagpur Experimental Farm in the Central Provinces for the year ending 1889-90.
		Report on the railway-borne traffic of the Central Provinces for the year ending the 31st March 1890.
		Abstract account of the treatment and outturn of the experimental portion of the Government Farm, Nagpur, from 1884-85 to 1889-90.
NEW YORK . . .	Observatory . . .	Abstract of Registers from Draper's self-recording instruments for January to December 1890.
		Annual Report for 1889.
OXFORD . . .	Radcliffe Observatory . . .	Results of meteorological observations made at the Radcliffe Observatory, Oxford, in the year 1886.
		Bulletin International, 28th February 1890 to 26th February 1891.
		Bulletin Mensuel, February to December 1890.
PARIS . . .	Bureau Central Météorologique de France.	Rapport du Comité Météorologique international-Réunion de Zurich, 1888.
		Annales, année, 1885 Tome II, 1886 Tome II, 1887 Tomes I, II, and III.
		Mission Scientifique du Cap Horn, 1882-83, Tome II Meteorologie and Tome III Magnetisme Terrestre.
PHILADELPHIA . . .	Franklin Institute . . .	Journal, April 1890 to February 1891.
POLA . . .	Hydrographische Ampte . . .	Meteorologische und magnetische beobachtungen for February to December 1890.
		Jahres übersicht der meteorologischen und magnetischen beobachtungen für 1889.
POMPEI . . .	Il-Rosario e la Nuova Pompei . . .	Le Armonie della Religione e della Civiltà nella nuova Pompei, Programma delle feste di Maggio 1890.
		Periodico mensile December 1890 and January 1891.
POONA . . .	Tidal and Levelling Operations, Survey of India.	Tide Tables for the Indian Ports for the year 1891.
PRAGUE . . .	K. K. Sternwarte . . .	Magnetische und meteorologische beobachtungen for 1889.
PUEBLA . . .	Observatorio Meteorologico del Colegio del Estado de Puebla.	Resumen correspondiente a cada dia, January to October 1890.
		Ensayo de meteorognosia de la Ciudad de Puebla.
		Note on the food-supply in Burma for August 1890 to February 1891.
RANGOON . . .	Director of Land Records and Agriculture, Burma.	Report on the experimental plantation at Mergui for the year 1889-90.
		Rice crop prospects in the ten chief rice-producing districts in Lower Burma for 30th September 1890 to 31st January 1891.

Presentations to the Library from the 1st April 1890 to the 31st March 1891—continued.

Place.	Donor.	Title of Works.
RIO-DE-JANEIRO	Imperial Observatory . . .	Revista do observatorio, January 1890 to January 1891.
	Barão De Capanema . . .	Annuario, 1888, 1889, and 1890.
RIPOSTO . . .	Osservatorio Meteorologico del R. Istituto Nautico di Riposto.	Boletins Mensaes do 1º observatorio Meteorologico da Repartição dos Telegraphos do Brasil, Vol. III, Anno de 1888.
ROME . . .	Afficio Centrale Meteorologi Geodinamica.	Bollettino mensile, March 1890 to January 1891.
ROUSDON (Devon) . . .	C. E. Peck . . .	Bellettino Meteorico, March 1890 to February 1891.
S. PAULO . . .	Commissão Geographica E. Geologica.	Meteorological observations made at the Rousdon observatory for 1889.
SAN SALVADOR . . .	Observatorio Meteorológico y Astronómico.	Boletim da Commissão Geographica E. Geologica da Provincia de S. Paulo, No. 3.
SIMLA . . .	Meteorological Reporter to the Government of Punjab.	Observaciones meteorológicas for January 1889 to June 1890.
SINGAPORE . . .	Colonial Secretary, Straits Settlements.	Summary of the meteorological conditions prevailing over the Punjab, February 1890 to January 1891.
ST. PETERSBURG	Minister of Finance . . .	Annual Report on meteorological observations in the Straits Settlements for 1889.
	Physical Central Observatory . . .	Russie d'Europe, Epaisseur de la couche de neige au commencement de l'evrier 1890.
	Alex Woeikof . . .	Annalen des Physikalischen Central-observatoriums, Jahrgang 1888 and Jahrgang 1889, Theil I.
		Repertorium für Meteorologie, Band XII.
SYDNEY . . .	Observatory . . .	Der einfluss einer schneedecke auf Boden Klima und Wetter.
		Voyage aux Salines d' Iletz et au pays voisin.
		Meteorological observations at Sydney for October to December 1877, January, February, and April to October 1890.
SYRACUSE . . .	Observatory . . .	Daily area of rainfall in New South Wales for February to May 1890.
		Results of rain, river and evaporation observations made in New South Wales during 1889.
TASMANIA . . .	Royal Society . . .	Results of meteorological observations made in New South Wales during 1878, 1879, and 1888.
TOKIO . . .	Imperial Meteorological Central Observatory.	Osservazioni meteorologiche, Anno XIV, Nos. 6 to 9.
		Papers and Proceedings for 1889.
		Annual Meteorological Report, Part II of 1887, and Part I of 1888.
		Monthly summaries and means for the year 1887 with 41 maps, and for the year 1888 with 41 maps.
TORONTO . . .	Meteorological Office . . .	Report of the meteorological observations made at the Imperial meteorological stations, Nagasaki, Kioto, Osaka, Hiroshima, Wakayama, Kochi, Miyasaki, and Kogoshima for the year 1886.
		Report of the meteorological observations in the Empire of Japan for November 1884 to December 1885.
TRIESTE . . .	Osservatorio Marittimo . . .	Report of the meteorological observations made at Kogoshima, Miyasaki, Kochi, Wakayama, Oita, Hiroshima, Osaka, Kioto, Nagasaki, Itsugahara, Akamagasaki, Sakai, Gifu, Hamamatsu, Numazu, Tokio, Choshi, Kanazawa, Fushiki, Niigata, Akita, Fukushima, Ishinomaki, Miyako, Aomori, Hakodate, Suitsu, Sapporo, Erimo, Soya, Kamikawa, Nemuro for January 1889 to March 1890; at Tsu and Yamagata for July 1889 to March 1890; at Abashiri for August 1889 to March 1890; at Nagano for January to March 1890; at Kumamoto for February and March 1890.
		Monthly Weather Review, January to October 1890.
		General Meteorological Register, Toronto, for the year 1889.
		Rapporto Annuale, Vol. IV, 1887.

Presentations to the Library from the 1st April 1890 to the 31st March 1891—continued.

Place.	Donor.	Title of Works.
TURIN . . .	Osservatorio Astronomico della Regia Università di Torino.	Bollettino dell Osservatorio della Regia Università di Torino, Anno XXII, 1887.
		Osservazioni meteorologiche fatte nel anno, 1889.
		Effemeridi del Sole e della Luna per l'orizzonte di Torino e per l'Anno 1891 calcolate dall' Ingegnere Tomaso Aschieri.
		Intorno all' Eclisse totale di Luna del 28 Gennaio 1888 Nota di Francisco Porro.
		Sulla differenza di longitudine fra gli osservatorii Astronomici di Milano e di Torino.
	Società Meteorologica Italiana	Sulla stella variabile <i>U Orionis</i> (Chandler 2100)—Nota di Francesco Porro.
		Sulle determinazioni di latitudine eseguite negli anni 1888, 1889, 1890, all' Osservatorio di Torino—Comunicazione preliminare di Francesco Porro.
		Bollettino Mensuale pubblicato per cura dell' Osservatorio Centrale del R. Collegio Carlo Alberto in Moncalieri, Serie II, Vol. IX, No. XI; Vol. X, Nos. 2 to 12; Vol. XI, No. 1.
		<i>P. F. Densa</i> —L' anticiclone del Novembre 1889; Le alte pressioni del Dicembre 1889 E Gennaio, 1890; La inclinazioni magnetica a Roma.
		Annuario Meteorologico Italiano, Anno VI, 1891.
UPSALA . . .	Meteorological Observatory	<i>J. Fuhlin</i> —Sur la température nocturne de l'air.
		<i>S. A. Hjeltström</i> —Sur la conductibilité de la neige.
		<i>N. E. Kholm</i> .—Ueber die einwirkung der ablen-kenden kraft der erdrotation auf die luftbewegung; Sur la chaleur latente de vaporisation de l'eau et la chaleur spécifique de l'eau liquide.
UTRECHT . . .	Royal Dutch Meteorological Institute.	Bulletin Mensuel, Vol. XXI, Année 1889.
		Barometerstanden en vinden in de Golf Van Aden en den Indischen oceaan bij Kaap Guardafui.
VIENNA . . .	K. K. Central Anstalt für Meteorologie und Erdmagnetismus.	Nederlandsch Meteorologisch Jaarboek Voor 1889.
		Jahrbuch, Jahrgang 1888, Band XXV.
	K. K. Geologischen Reichsanstalt	Wetterbericht, 1st February to 31st December 1890.
		Verhandlungen Nos. 3 to 18 of 1890, and No. 1 of 1891.
WASHINGTON .	Chief Signal Office . . .	Annual Summary of Monthly Weather Review for 1889.
		Monthly Weather Review of the United States for January to November 1890.
		Weather Chart of the United States for 8 A.M. and 8 P.M., for February 1890 to January 1891.
		Report of the Chief Signal Officer, War Department, for 1889, Parts I and II.
		Summaries of International Meteorological observations for July to December 1888.
	H. A. Hazen . . .	Supplement to Weather Chart of United States of America for January to June 1889.
		Annals of the observatory of Harvard College, Vol. XXII, being observations made by the United States Signal Service on Peke's Peak during 1874—88.
		Daily International Chart for July to December 1884.
		Annual Report of the Chief Signal Officer of the Army to the Secretary of War for the year 1890.
		Determination of prevailing wind direction; Reduction of air pressure to sea-level; Instructions to voluntary observers of the Signal Service; Determination of air temperature and humidity; Cloud formation; Anemometer comparisons; storms and central ascending currents; Thermometer Exposure; The relation between wind velocity and pressure; On vertical currents in cyclones; Pressure and temperature in low and high pressure area; On the determination of the true air temperature; Hand-book of meteorological tables; Tornadoes.
	Hydrographic Office . . .	Pilot Chart of the North Atlantic Ocean for April 1890 to February 1891.

Presentations to the Library from the 1st April 1890 to the 31st March 1891—concluded.

Place.	Donor.	Title of Works.
WASHINGTON — <i>contd.</i>	United States Geological Survey	Seventh Annual Report of the United States Geological Survey for 1885-1886.
		Eighth Annual Report of the United States Geological Survey for 1886-87, Parts I and II.
		Monographs of the United States Geological Survey, Vol. XV, Parts I and II, Vol. XVI.
		Bulletin of the United States Geological Survey, Nos. 54 to 57.
	United States Naval Observatory.	Washington observations, 1884, Appendix I; Yarnall's catalogue of Stars observed at the United States Naval Observatory during the years 1845 to 1877, Third edition, revised and corrected.
		Report of the Superintendent of the United States Naval Observatory for the year ending 30th June 1890.
WELLINGTON .	Colonial Museum and Geological Survey of New Zealand.	Washington observations, 1885, Appendix I; International Astrophotographic Congress, &c., by A. G. Weirter hatter.
		Appendix II—Saturn and its Rings, 1875-89, by Asoph Hall.
		Twenty-fourth Annual Report on the Colonial Museum and Laboratory for 1888-89.
		Studies in Biology for New Zealand students, No. 4.
ZI-KA-WEI . . .	Observatory	Catalogue of the Colonial Museum Library.
ZURICH	Swiss Meteorological Institute	Reports of Geological explorations during 1888-89.
		Bulletin Mensuel, October 1889 to July 1890.
		Meteorologische Beobachtungen, July 1889 to April 1890.

Purchases for the Library.

- American Journal of Science, January 1890 to February 1891.
 American Meteorological Journal, October 1889 to January 1891.
 Annalen der Physik und Chemie, Nos. 3 to 12 of 1890; Nos. 1 to 3 of 1891.
 British Journal, Photographic Almanac and Photographer's Daily Companion for 1891, J. T. Taylor.
 Cartes Synoptiques Journalieres du Temps embrassant le Nord de l'Atlantique et une partie des continents avoisinants publiees par l'Institut Meteorologique Danois et le Deutsche Seewarte, June to November 1886.
 Chamber's Mathematical Tables.
 Cloud Atlas by Dr. H. H. Hildebrandsson, Dr. W. Köppen, and Dr. G. Neumayer.
 Collection de memoires relatifs a la Physique, publies par la Societe Francoise de Physique, Vol. IV.
 Comptes Rendus de l'Academie des Sciences, Vol. CX, Nos. 8 to 26; Vol. CXI, Nos. 1 to 26; Vol. CXII, Nos. 1 to 8.
 Cours d'Analyse Infinitesimale par J. Boussinesq, Tomes I and II.
 Cycles of drought and good seasons in South Africa by D. E. Hutchins.
 Elemente der Physik, Meteorologie und Mathematischen Geographie by Von Professor Dr. Paul Reis.
 Elementary Meteorology by R. H. Scott.
 Elliptic Functions by A. L. Baker, C.E.
 Guide Book to the Local Marine Board Examination by T. L. Ainsley.
 Introduction to the Logic of Algebra with illustrative Exercises by E. W. Davis, Ph.D.
 La Nature, Nos. 875 to 926.
 Meteoritic Hypothesis of the origin of Cosmical Systems by J. Norman Lockyer, F.R.S.
 Nature, Nos. 1063 to 1114.
 Nautical Almanac for 1891.
 Oeuvres de Fourier publiees par les soins de M. Gaston Darboux sous les auspices du Ministère de l'Instruction publique, Tomes I and II.
 Philosophical Magazine and Journal of Science, April 1890 to March 1891.
 Popular Treatise on the winds by W. Ferrel.
 Report of the British Association for the advancement of Science for 1889.
 Studies in Statistics by G. B. Longstaff.
 Thacker's Indian Directory for 1891.
 Theorie des Fonctions Elliptiques par M. M. Briot et Bouquet.
 Theorie der gasbewegung by Von Georg Lindner.
 Theory of Determinants, Part I, Muir.
 Theory of Differential Equations, Part I. Forsyth.
 Theory of Light by J. Preston.
 Webster's English Dictionary.
 Year Book of Photography and Photographic News Almanac for 1891.

APPENDIX B.

List of Recipients of the Publications of the Meteorological Office.

Adelaide	Meteorological Observatory.
Agra	Editor of the <i>Delhi Gazette</i> .
Akyab	Port Officer.
Algeria	Meteorological Service of the Ecole des Sciences d' Alger.
	Secretary to the Government, North-Western Provinces and Oudh.
Allahabad	Meteorological Reporter, ditto ditto.
	Sanitary Commissioner, ditto ditto.
	Editor of the <i>Pioneer</i> .
Amraoti	Commissioner, Hyderabad Assigned Districts.
Amsterdam	Sanitary Commissioner for Berar.
	Royal Academy of Sciences.
Bangalore	Inspector-General of Forests, Mysore.
	Resident in Mysore.
Bassein	Chief Commissioner of Coorg.
Batavia	Port Officer.
Berlin	Magnetical and Meteorological Observatory.
	Geographical Society.
	Royal Prussian Meteorological Institute.
	Secretary to the Government of Bombay.
	Meteorological Reporter for Western India.
	Colaba Observatory.
	Sanitary Commissioner with the Government of Bombay.
	Bombay University.
	Asiatic Society of Bombay.
Bombay	Sassoon Mechanics Institute.
	Coimbra Observatory (through Consul-General for Portugal in British India).
	Editor of the <i>Bombay Gazette</i> .
	Ditto <i>Times of India</i> .
	Port Officer.
	Director of the Indian Marine.
Bolarum	Secretary to the Government of Bombay, Marine Department.
Brisbane, Queensland	Superintending Engineer, Hyderabad Public Works Department.
	Government Meteorologist.
Brussels	Royal Academy of Sciences.
	Royal Observatory.
Bucharest, Roumania	Meteorological Institute.
Budapesth	Observatory.
Cairo	Services Sanitaires et d' Hygiene Publique.
Cachar	Deputy Commissioner.
	Private Secretary to His Excellency the Viceroy.
	Secretary to the Government of India, Revenue and Agricultural Department.
	Ditto ditto Home Department.
	Ditto ditto Public Works Department.
	Ditto ditto Department of Finance and Commerce.
	Ditto ditto Military Department.
Calcutta	Secretary to the Government of Bengal, Revenue Department.
	Meteorological Reporter to the Government of Bengal.
	Surveyor-General of India.
	Geological Survey of India.
	Sanitary Commissioner with the Government of India.
	Ditto to the Government of Bengal.
	Superintendent, Botanical Gardens, Shibpore.
	Asiatic Society of Bengal.
	Indian Museum Library.
	Trustees of the Indian Museum.

List of Recipients of the Publications of the Meteorological Office—continued.

	Calcutta University.
	Presidency College.
	Public Library.
	Editor of the <i>Statesman and Friend of India</i> .
	Ditto <i>Englishman</i> .
	Ditto <i>Indian Daily News</i> .
	Ditto <i>Hindu Patriot</i> .
	Ditto <i>Indian Engineering</i> .
Calcutta—contd.	St. Xavier's College Observatory.
	Alipore Observatory.
	Mint Master.
	Indian Association for the Cultivation of Science.
	Port Officer.
	Deputy Conservator, Port Approaches.
Cambridge	University Library.
Cambridge, Massachusetts	Harvard College Library.
Cape of Good Hope	Astronomer Royal.
Carlsruhe, Baden, Germany	Bureau für Meteorologie und Hydrographie.
Cawnpore	Director of Land Records and Agriculture, North-Western Provinces and Oudh.
Chandbali	Port Officer.
Chatham	Royal Engineers' Library.
Chemnitz	Royal Meteorological Institute.
Chittagong	Port Officer.
Christiania	Norske Meteorologiske Institut.
	Royal Observatory.
Colombo	Editor of the <i>Ceylon Times</i> .
	Ditto <i>Ceylon Observer</i> .
	Surveyor-General of Ceylon.
Copenhagen	Danske Meteorologiske Institut.
	Royal Danish Academy of Sciences.
	Meteorological Office.
Cordoba	National Academy of Science.
	Servicio Meteorologico de la Provincia de Cordoba.
Dacca	Dacca College.
Darjeeling	Conservator of Forests, Bengal.
	Editor of the <i>Indian Forester</i> .
Dehra Dun	Superintendent, Great Trigonometrical Survey.
	Forest School.
Dublin	Royal Dublin Society.
Dibrugarh	Deputy Commissioner, Lakhimpur.
Edinburgh	Scottish Meteorological Society.
	Astronomer Royal for Scotland.
	Scottish Geographical Society.
False Point	Port Officer.
Florence	R. Biblioteca Nazionale Centrale di Firenze
Folkestone	H. F. Blanford, Esq., F.R.S.
Greenwich	Astronomer Royal, Royal Observatory.
Goa	Meteorological Observatory.
Goalpara	Deputy Commissioner.
Gauhati	Ditto ditto Kamrup.
	Commissioner, Assam Valley Districts.
Giessen	Oberhessische Gesellschaft für Natur und Heilkunde.
Hamburgh	Deutsche Seewarte.
	Deutsche Meteorologische Gesellschaft.
Havana	Real Colegio de Belen.
Hong-Kong	Observatory.
Hyderabad	Conservator of Forests, Sind Circle.
Indore	Agent to the Governor General for Central India.
Iowa, U. S.	Dr. Gustavus Henrichs.
Jeypore	Maharajah's Observatory.
Jubbulpore	Civil Surgeon.
Katmandu	Resident at Nepal.
Khandwa	Civil Surgeon of Nimar.

List of Recipients of the Publications of the Meteorological Office--continued.

Kohima	Deputy Commissioner, Naga Hills.
Kew	Observatory.
Kidderpore	Deputy Director, Indian Marine.
	Secretary to the Government of the Punjab.
Lahore	Sanitary Commissioner ditto ditto.
	Conservator of Forests, Punjab.
	Meteorological Observatory.
Leeds	Yorkshire College.
Leipzig	Geographical Society.
Lisbon	Observatorio de Infante d'Luiz.
	Royal Academy of Science.
	Her Majesty's Secretary of State for India.
	Meteorological Council
	Royal Society.
	Royal Asiatic Society.
	Northbrook India Club.
	Society of Arts.
	Institution of Civil Engineers.
	Royal School of Mines.
	Royal Meteorological Society.
London	Admiralty Library.
	United Service Institution.
	British Museum.
	Editor of the <i>Philosophical Magazine</i> .
	Ditto <i>Athenæum</i> .
	Ditto <i>Nature</i> .
	Ditto <i>Symons' Monthly Meteorological Magazine</i> .
	Ditto <i>Westminster Review</i> .
	Ditto <i>Ironmonger</i> .
	Organizing Committee of the Imperial Institution of the United Kingdom, the Colonies and India.
	Secretary to the Government of Madras.
	Ditto ditto, Public Works Department.
	Meteorological Reporter to the Government of Madras.
	Government Astronomer, Madras.
	Sanitary Commissioner, ditto.
	Madras University.
	Editor of the <i>Madras Times</i> .
Madras	Ditto <i>Madras Mail</i> .
	Ditto <i>Christian College Magazine</i> .
	Government Central Museum.
	Assistant Director of Land Records and Agriculture, Government of Madras.
	Surgeon-General, H. M.'s British Forces.
	Ditto with the Government of Madras.
	Presidency Port Officer.
	Conservator of Forests, Northern Circle.
	Ditto ditto, Southern Circle.
	Revenue Survey Department.
Madrid	Royal Observatory.
Magdeburg	Observatory of the Magdeburg Zeitung.
Manchester	Literary and Philosophical Society.
Manila	Meteorological Observatory.
Mauritius	Meteorological Society.
	Observatory.
Melbourne, Victoria	University Library.
	Public Library, Museum, and Natural Gallery.
	Central Meteorological Observatory.
Mexico	Sociedad Científica "Antonio Alzate."
Milan	Royal Astronomical Observatory.
	Governor-General's Agent in Rajputana and Chief Commissioner of Ajmere-Merwara.
Mount Abu	Secretary to the ditto ditto ditto ditto P. W. D.
Monte Video	Meteorological Central Observatory.
Moulmein	Port Officer.

List of Recipients of the Publications of the Meteorological Office—continued.

Munich	Royal Observatory.
	Royal Academy of Sciences.
	Geographical Society.
	Royal Meteorological Central Station.
	Chief Commissioner, Central Provinces.
Nagpur	Sanitary Commissioner, ditto.
	Inspector-General of Education, ditto.
	Meteorological Observatory.
Naini-Tal	Conservator of Forests, Central Provinces.
	Ditto ditto, Central Circle, North-Western Provinces and Oudh.
New Haven, Connecticut	Academy of Arts and Sciences.
New York, U. S.	Editor of the <i>American Journal of Science</i> .
Nowgong (Assam)	Meteorological Observatory.
	Deputy Commissioner.
Oxford	Radcliffe Library.
	Radcliffe Observatory.
	Observatoire Municipal de Montsouris.
	Editor of <i>La Nature</i> .
Paris	Physical Observatory, Meudon.
	Bureau Central Météorologique de France.
	Meteorological Society of France.
Perpignan, France	Observatoire Météorologique et Magnétique.
Perth, W. Australia	Meteorological Reporter.
Pesaro, Italy	Magnetical and Meteorological Observatory.
Philadelphia	Franklin Institute.
Pesna	Conservator of Forests, Northern Circle, Bombay Presidency.
Prague, Bohemia	K. K. Sternwarte.
Puebla	Colegio del Estado de Puebla.
Quebec	Literary and Historical Society.
Rangoon	Civil Surgeon.
	Chief Commissioner, Burma.
	Sanitary Commissioner, ditto.
	Conservator of Forests, Pegu Circle.
	Editor of the <i>Rangoon Times</i> .
	Chamber of Commerce, Burma.
	Port Commissioners.
	Port Officer.
	Agricultural and Horticultural Society.
	Central Meteorological Office.
Rome	Vatican Observatory.
Rio de Janeiro	Imperial Observatory.
Sahasnagar	Superintendent, Botanical Gardens.
Santiago	Observatorio Nacional.
San Salvador	National Institution.
Silbagar	Deputy Commissioner.
	Ditto ditto.
Sylhet	Civil Engineering College.
Subore	Secretary to the Chief Commissioner of Assam.
	Ditto ditto ditto Public Works Department.
	Conservator of Forests, Assam.
Shillong	Deputy Commissioner, Khasi and Jaintia Hills.
	Director of Land Records and Agriculture.
	Sanitary Commissioner.
Simla	Assistant Quarter Master General, Intelligence Branch.
Singapur	Principal Civil Medical Officer, Straits Settlements.
Stockholm	Nautisk Meteorologiska Byran.
	Physical Central Observatory.
St. Petersburg	Imperial Geographical Society of Russia.
	Prof. H. Wild. Physical Central Observatory.
Strasbourg	Imperial University Library.
	Observatory.
Sydney	University Library.
Syracuse, Sicily	Royal Meteorological Observatory.

List of Recipients of the Publications of the Meteorological Office—concluded.

Tasmania	Royal Society.
Tiflis, Russia	Physical Observatory.
Tokio, Japan	Imperial Mining Office.
Toronto, Canada	Meteorological Central Observatory.
	Meteorological Office.
Turin	Royal Astronomical Observatory.
Tura	Meteorological Society of Italy.
Tezpur	Deputy Commissioner, Garo Hills.
Upsala	Ditto Darrang.
Utrecht	Meteorological Observatory.
	Royal Netherlands Meteorological Institute.
	K. K. Central-Anstalt für Meteorologie und Erdmagnetismus.
	K. K. Geologische Reichsanstalt.
Vienna	Imperial Academy of Sciences.
	Dr. J. Hann.
	Prof. Dr. T. M. Pernter.
Vizagapatam	A. V. Nursingrow, Esq.
	Chief Signal Officer, United States Army.
	Smithsonian Institution.
Washington, U. S.	United States Naval Observatory.
	Hydrographic Office.
	Prof. Cleveland Abbe.
	United States Geological Survey.
Wellington, New Zealand	Colonial Museum.
Whalle (England)	Stonyhurst College Observatory.
Woolwich	Royal Artillery Library.
Zi-ka-wei, Shanghai	Magnetical and Meteorological Observatory.
Zurich	Central Meteorological Office.